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CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL

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NEW SERIES, VOL. III.—No. 1.
TORONTO AND MONTREAL, CANADA, JANUARY, 1893.
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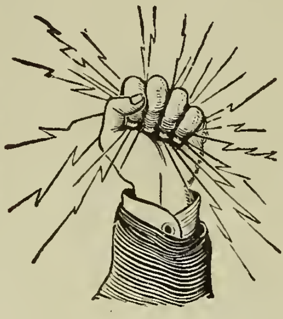

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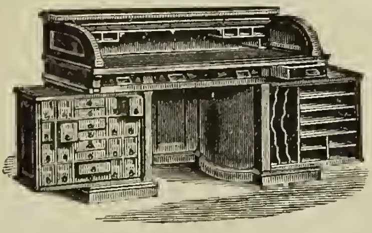

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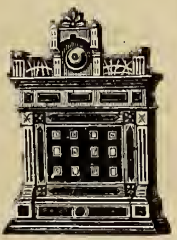

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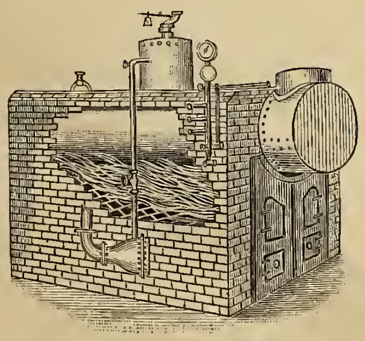

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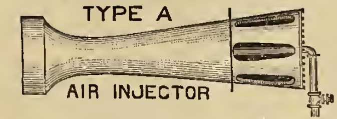

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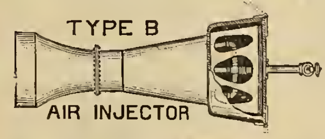

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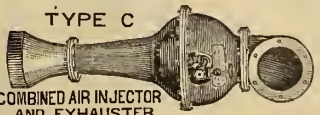

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DEAR SIR,—We have had in use for some time, your Combined "Air Injector and Exhauster" and with pleasure we state that it is giving us the most complete satisfaction. Regarding the saving in fuel, we were burning, before using the "Injector," two tons soft coal per week, at a cost of $9.00; after we put the Injector in, we burn two ton hard coal screenings per week at a cost of $2.00 making a saving of $7.00 per week, which speaks for itself. We have a much cleaner and better fire and far less trouble in keeping steam. We consider your invention a boon to all parties using steam boilers. Wishing you every success, we are, Yours truly, (Signed) THE CANADIAN OILED CLOTHING Co. per S. Henderson, Manager.

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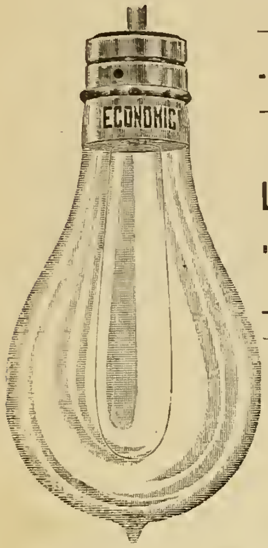

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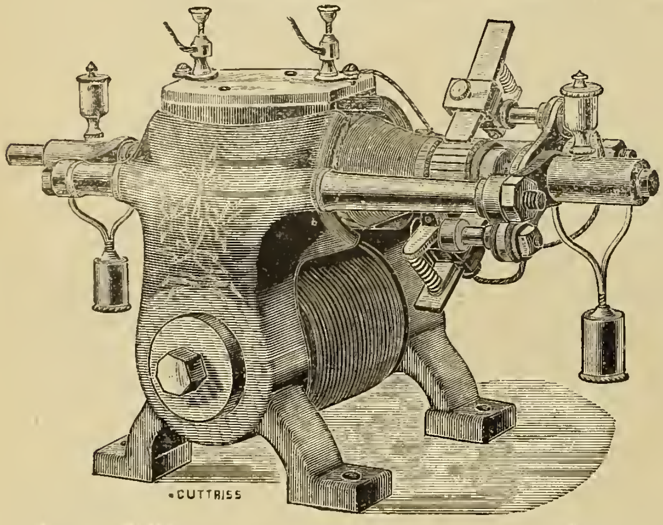

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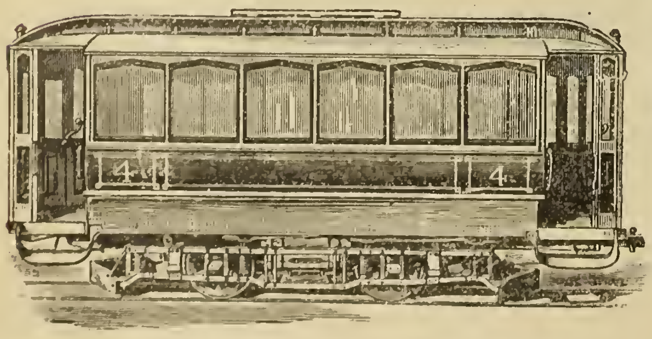

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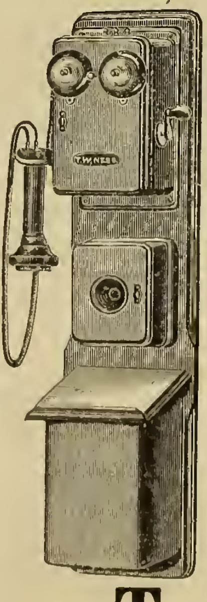

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CANADIAN
ELECTRICAL NEWS
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STEAM ENGINEERING JOURNAL.

VOL. III. TORONTO AND MONTREAL, CANADA, JANUARY, 1893. NO. 1.

CANADIAN ELECTRICAL ASSOCIATION.

January 25th and 26th the date of the Second Convention.

THE second convention of the Canadian Electrical Association will take place in Toronto on Wednesday and Thursday, January 25th and 26th, 1893.

SCHOOL OF PRACTICAL SCIENCE, TORONTO,
IN WHICH WILL BE HELD THE SECOND CONVENTION OF THE CANADIAN ELECTRICAL ASSOCIATION, JAN. 25TH AND 26TH, 1893.

An illustration of the School of Practical Science, in which the Association has been kindly invited to meet, is presented on this page. This institution, as the result of large expenditures made last year by the Ontario Government, is now equipped with a first-class physical laboratory, including the leading types of electrical apparatus. Members of the Association will on the occasion of the approaching convention be afforded an opportunity of thoroughly inspecting the school, which is designed to lay the foundation of a practical training for our young men, and from which will graduate many youths who will be connected with the electrical industries of the country in the future.

The convention will assemble in the School of Practical Science, as stated, at 2:30 o'clock on Wednesday, the 25th inst. It is expected that the balance of that day, as well as the whole of the day following, will afford little enough time in which to dispose of the business.

The Committees appointed at the Hamilton convention in June last will present their reports. Amendments to the constitution and by-laws will receive further consideration. There is likewise to be considered the important question of the division of the Association into sections representative of the various branches of the electrical industry, as suggested at the Hamilton meeting. This step is by many of the members considered to be necessary to the proper and efficient working of the Association, as well as in the best interests of the different departments of the electrical field.

A number of papers on subjects of special interest are in process of preparation for presentation and discussion at the convention. Among these may be mentioned a paper by Prof. Rosebrugh of the School of Practical Science; papers on "Testing," by Mr. Black, of the G. N. W. Telegraph Co., Hamilton; "Free Wiring," by Mr. J. M. Campbell, of the Electric Light & Power Co., Kingston, Ont.; "Underground Construction," by Mr. W. A. Tower, of the Bell Telephone Co., Toronto; "Steam Plant and Management in Electric Lighting Stations," by Mr. A. E. Edkins, President of the Executive of the Canadian Association of Stationary Engineers. Visits of inspection will be made to the central stations of the local lighting companies and also to the new Exchange of the Bell Telephone Co.

On the evening of the first day of the convention a social entertainment will be provided down town.

The headquarters of the Association during the convention will be at No. 40 York street, at which address delegates are requested to call on arrival in the city and obtain all necessary information. Programs of the convention are now being mailed direct to members' addresses, and it is hoped that as large a number as possible will be in attendance prepared to take an active part in the proceedings of the meetings.

MONTREAL ELECTRIC CLUB.

Editor ELECTRICAL NEWS.

DEAR SIR,—The Montreal Electric Club was organized at a meeting held on the 12th inst. at Mr. W. B. Shaw's residence on Burnside street. The meeting was well attended, and the outlook of the Club is very promising. Messrs. E. Craig, A. Morgan and L. Granell were appointed a committee to formulate By-laws. The object of the club primarily is the mutual advancement of its members in knowledge of electrical science.

Mr. W. B. Shaw was appointed President, Mr. J. A. Farlinger Vice-President, Mr. J. Burnett Secretary-Treasurer.

The membership of the Club is to be confined to persons in the electrical business, it being found preferable to confine the membership to practical men and practical subjects.

Yours truly,
JAMES BURNETT,
Sec.-Treas.

RESOLUTION OF CONDOLENCE.

Whereas it has pleased our allwise Creator and Heavenly Father to remove from this earth Horace, the son of our worthy friend and esteemed Bro. Geo. Fowler; be it

Resolved—That while we bow in humble submission to the divine will of our Heavenly Father, we at the same time extend our sincere and heartfelt sympathy to Bro. Fowler, his wife and family in this their hour of sorrow, and be it further

Resolved—That a copy of these resolutions be sent to Bro. Fowler and also to the ELECTRICAL NEWS for publication.

Signed on behalf of Toronto No. 1, C. A. S. E.

A. E. EDKINS
WILSON PHILLIPS } Committee.
C. MOSLEY

November 25th, 1892.

TRY-COCKS.

TRY-COCKS on a boiler are important things, and should be so designed and arranged that they can be used with facility, and without the inconveniences and annoyance that they ordinarily give rise to. As usually made they are apt to leak continually. This in itself is a sufficient annoyance to call for some remedy, and the remedy that is too often applied is to stop up each leaking one by driving a pine plug into it. The wooden handles with which they are provided crack under the influence of the heat and moisture to which they are subjected and eventually fall off, so that the fireman has to use a pipe wrench, perhaps, to open them. Even when they are in good condition, and the fireman tries them faithfully, he is probably rewarded by seeing a voluminous spray of mud blown all over his boiler front; for mud will collect in the connections even if there is none elsewhere. This trouble is avoided, in some places, by providing a copper waste pipe, which receives the discharge from the try-cocks through small funnels brazed into it on the upper side. Such an arrangement proves very effective and satisfactory when the try-cocks are connected directly over each other, it is not easy to arrange such a waste pipe so that it will be effectual without being unsightly.

The lead or composition seats with which try-cocks are usually provided soften up under the influence of the heat to which they are subjected, especially when high pressures are used; and the fireman, in attempting to close the cocks tightly enough to prevent leakage, often jams the seats out of shape. Part of the seat is forced into the steam opening, forming a nipple, which greatly obstructs the flow of steam. In some cases these nipples are of such length that it becomes necessary to turn the cock till it nearly comes out of the thread before steam will blow freely through. It is true that the seats can be replaced, but this will usually have to be done on Sunday or a holiday, when the plumber's irons are cold. Moreover, it requires some time and patience to tin the recess for the filling and get a good job.

Another very annoying trouble is frequently experienced. Owing to the smallness of the nozzles of the cocks (usually about 5-32 or 3-16 of an inch), a slight deposit in them of scale or other similar substance will materially check the free flow of steam that should take place. The stems are usually not packed and the threads are apt to fit loosely. The result of these various circumstances is that when the fireman opens the cock a spray of hot and muddy water blows out through the loose thread and he receives it, perhaps, in his sleeve. At all events, he finds it unpleasant to use such try-cocks, and the result is apt to be that he trusts implicitly in the glass gauge, and leaves the try-cocks to themselves, plugged up, perhaps, to keep them from leaking.

There seems to be no good reason why ⅜-inch and ½-inch angle valves may not be used in the place of the conventional try-cock, for there are many advantages in such an arrangement, and there is practically no difference in the expense. The angle valves are merely substituted for the ordinary cocks, and nipples, running off at an angle, are screwed into them. The nipples from the angle valves should open freely into the air.

By the use of angle valves many of the annoyances incident to the common try-cock can be avoided. The stems of the valves can be kept packed, so that no trouble from leakage in this direction need be feared. A small deposit of scale makes but little difference in the efficiency of the arrangement, on account of the enlarged area of discharge; and if a troublesome deposit should collect, the bonnet of the valve may be removed and the pipe, being of conveniently large size, can be cleaned out by a small rod or a stout wire. Another point of material advantage in the proposed arrangement is that the seats of the angle valves can be easily removed and replaced by new ones in a few minutes, so that the valves can be kept tight. (It is true that these small valves usually have solid seats, but they can be had with removable seats, if desired.) Under these conditions there will be no temptation to the fireman to neglect the try-cocks.

There is one objection to the use of angle valves that should be considered, though it does not appear to us to be very weighty. In removing and replacing the bonnet of the valve the fireman is apt to use too large a wrench and to screw the bonnet up with more force than is necessary. The result is apt to be that, after removing and replacing it a few times, the hexagonal nut becomes sheared all out of form, so that it is neither hexagonal, nor square, nor round, nor any other particular shape. Then he is apt to call loudly for a new valve. This has been the experience of some few of those who have used angle valves as suggested above, but we think this trouble can be avoided by a few words of caution to the fireman.

We may mention in this connection, another point that applies equally to angle valves and try-cocks. The tendency in these days is very noticeably toward the use of higher steam pressures than have been used in the past, and along with the higher pressures we must necessarily have higher temperatures to contend with. Thus saturated steam of 60 pounds pressure has a temperature of 307°F., while steam of 100 pounds has a temperature of about 348″, and at 125 pounds its temperature becomes 353°. Many alloys that will resist temperature of 307″for long periods of time soften up so much at 340″ or 350″ that they soon become unfit for use as valve seats. In such cases it is found that pure, soft copper can be substituted for the more fusible metals with good results.—*Locomotive.*

PUBLICATIONS.

"The Mineral Industry, Its Statistics, Technology and Trade in the United States and Other Countries, From the Earliest Times to the Close of 1892." A large octavo volume bearing the above title will be issued in January, 1893, by the Scientific Publishing Co., 27 Park Place, New York, and it is claimed will be the most complete and valuable report of mineral statistics ever published, and an indispensable reference book. Price $2 and $2.50.

OBITUARY.

The death is announced in Berlin, on the 6th of December, of Werner Von Siemens, the eminent German electrician, and founder of the firm of Siemens & Halske. The deceased was born December 13th, 1816, at Lenthe, in Hanover.

At a recent meeting of the Peterborough & Ashburnham Street Railway Company the following officers were elected: Jas. Stephenson, M. P., was elected president, and A. Stephenson, secretary treasurer.

Mr. J. W. Orme, the owner of the London and Lucan stage line, after having thoroughly looked into the matter, is about to give an order for an electric bus capable of accommodating the passenger and freight traffic of the entire line. The cost is estimated at $2,000. A storage battery and a 6 horse power motor will supply the power. It is expected that the route, a distance of 17 miles, will be covered in less than 2 hours.

INSTRUCTIONS FOR THE MANAGEMENT OF ELECTRIC CARS*

THE TROLLEY.

A continuous metallic contact is needed between the generators at the power station and the motors on the car, and the office of the trolley is to make this contact with the overhead wire, which is, of course, directly connected with the generators. The trolley and its appendages are therefore the first things that require attention. The principal parts are "Trolley-wheel and Yoke," the "Trolley-pole," the "Trolley-stand," the "Trolley-springs," the "Trolley-pole wire" and the "Trolley-wheel pin."

The Trolley-wheel is made of a metal that will give a free passage to the electric current, and at the same time stand the hard usage to which it is subjected. As it revolves at a very high speed, it becomes a very important matter to properly lubricate it. To effect this the Trolley-wheel pin is made hollow and small holes are drilled through the bearing part on which the wheel runs. The hollow is filled with an absorbent material and the pin is then soaked in oil until a quantity is soaked up to be gradually used as needed. The trolley-wheel and pins are parts, therefore, that require very careful watching, for, if not properly lubricated and kept in good condition they will wear very rapidly and soon become useless.

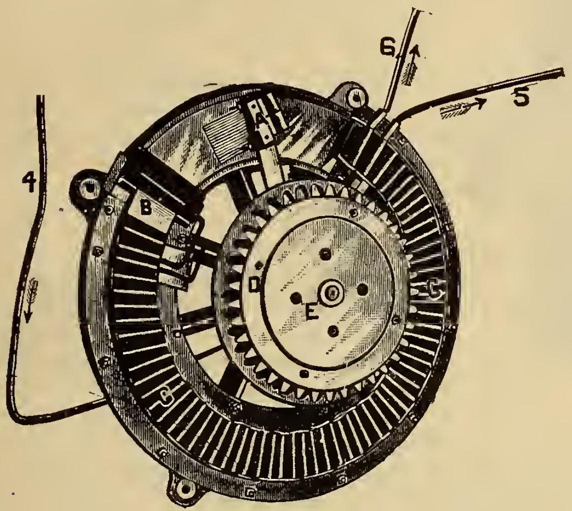

Fig. 1.—Rheostat.

The trolley-pole and trolley-stand need no description here. The stand is so constructed as to give complete freedom of movement to the pole and thereby insure the trolley-wheel remaining upon the overhead wire.

The trolley-pole wire is the wire that runs down the side of the trolley-pole and its use is to convey the current from the live wire to the machinery underneath the car. The current passes through the trolley-wire, through the wheel and pin, through the yoke, thence down the trolley-pole wire to the socket, through the trolley-stand to the wire leading to the cut out box.

The cut out box is simply a switch placed in the circuit to cut off the current, in case it is desired to work on or examine the motors or rheostat with the trolley on the wire for light or any other purpose. A car should never be left standing with the trolley on the wire unless the cut out switch is open. From the cut out box the current passes to the Fuse Box, thence to the Lightning Arrester and thence to the Rheostat.

The Fuse Box is the safety valve of the electric motor; it consists of a small wooden box containing a piece of wire, of such size and material that it will melt before the motors receive current enough to do any damage It is important that the heating effect of an electric current passing through a wire should be thoroughly understood in order to appreciate the value of the Fuse Box as a safety valve. Heat is generated in a wire by the passing of an electric current through it, and if the current that is forced through a wire is in excess of its safe carrying capacity the wire will heat to the danger point, or even become fused, and destroy the insulation, or in other words, "burn out the motor." Time is an element to take into consideration here, for heat cannot be produced without time. This must be remembered, for though generally it is proper to use a fuse wire that will melt when a current of the safe carrying capacity of the motor is reached, it is sometimes necessary to use a fuse wire of greater capacity than the maximum safe current.

The reason for this is that the motors require a much larger current for starting with a full load on a sharp curve, or on a heavy grade, than they can endure for any length of time. For this reason the fuse wire is much nearer the danger limit on motor cars than is common on stationary motors, and it will only protect the machines from sudden rushes of excessive current, therefore care should be taken in climbing long grades or in any place where the work is heavy and extends over any considerable time, that motors be subjected to no more current than is absolutely necessary.

At the ordinary voltage of the line and with the ordinary working current there is no connection with the ground; but should the voltage rise to such a point as would endanger the motors, as is the case when lightning strikes the line, provision must be made to pass the current direct to the ground before it gets to the motor.

The "Lightning Arrester" is a device through which the current passes that has a direct connection with the ground. At the ordinary voltage of the line there is no connection with the ground, but should the voltage rise to such a point as would endanger the motors the current will be shunted and pass over to the ground connection and escape.

To thoroughly understand the difference between the office of the Fuse Box and the Lightning Arrester, the difference between current and voltage must be understood. The Fuse Box is to protect from excessive current; the Lightning Arrester from excessively high voltage. A thorough understanding of this difference will also make plain the office of the "Rheostat," through which the current next passes.

THE RHEOSTAT.

The Rheostat is the throttle of the electric motor. It consists of an adjustable resistance placed in the circuit between the trolley and the motors for the purpose of cutting down or reducing the voltage or pressure on the line.

The Rheostats in use on the motors of this country are those known as the T-H, and consist, as will be seen by accompanying cut (Fig. 1), of a main casting or frame with a channel passing around the outer edge in which are laid the contact or resistance plates, C, C. Through the centre of this frame passes a spindle and engages the arm carrying the brush A by a kind of clutch.

The current enters the rheostat on the wire 4 in the direction indicated by the arrow. Wire 4 passes under the rheostat and connects with the spindle at its lower end. The spindle is insulated from the frame where it passes up through to the sprocket drum, so that the current cannot enter the frame, but must pass up to the arm, thence to the brush (A).

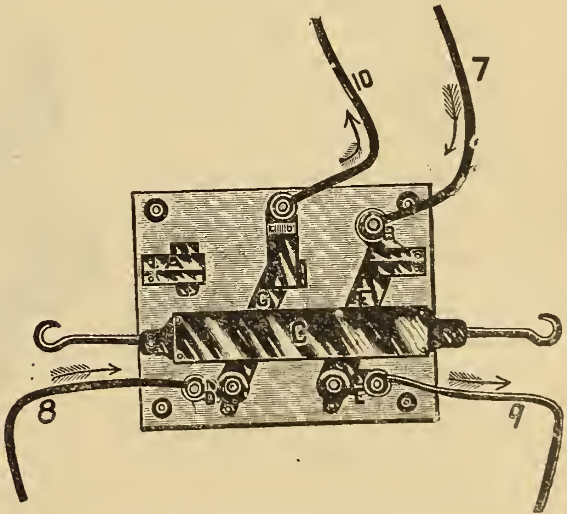

Fig. 2.—Reversing Switch.

The sprocket drum has a wood centre, or other means of insulating the rim (D) from the centre and spindle so that no current can pass into the chains that connect the rheostat with the controlling stand. Under ordinary circumstances when everything is in working order and the cut out switch is closed the arm and brush (A) are "charged" when the trolley is on the wire. Now, when the sprocket drum is turned the arm is carried around and the brush will be brought into contact with the "approach plate" (B). When the brush is on the approach plate (B) the current passes through the resistance (C C) and out on the wire (5) known as the "end wire" to the motors. The effect of the current passing this resistance is to cut down the voltage. Another effect of the current passing through this resistance is to develop heat and if long continued will burn out the resistance.

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*From "Twin City Ry. Trainmen's Guide,"

It is evident from this that the resistance of these plates should not be allowed to become impaired in any way. If this resistance gets "short-circuited" the motors will be subjected to the full voltage of the line at the start, which will start the car with a jerk and also endanger the machinery.

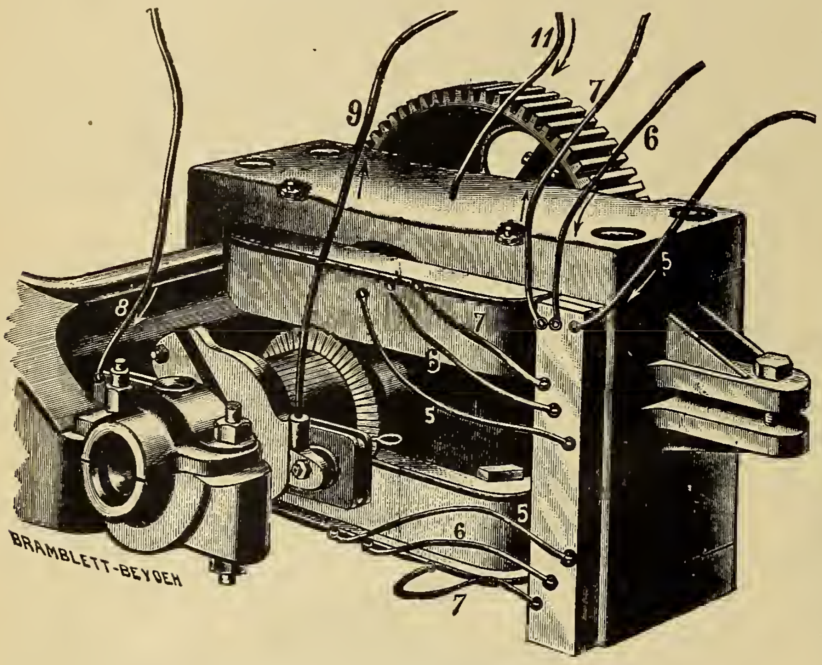

Fig. 3.—T.-H. Motor, S. R. G.

As the brush is moved around on the contact plate towards wires (5 and 6) this resistance becomes less and less until the brush reaches the contact to which wire (5) is connected when the resistance is all cut out, and the current at full voltage flows direct to the motors. Wire (6) is what is known as the "loop wire." The brush is moved on to the contact to which this wire is connected when a higher speed is desired. The connection of this wire at the motors will be explained in another chapter.

THE REVERSING SWITCH.

After passing the rheostat the current passes through the field coils of the motors, thence to the reversing switch, thence back to the armature and then to the ground.

The reversing switch (Fig. 2) is a device for reversing the flow of the current through the armature. It consists of a piece of well seasoned wood or other non-conducting material, upon which are mounted two oscillating levers G and F, which are connected together and operated by the insulating strip C. This method of operating the reversing switch may be seen by reference to the wiring diagrams, Figs. 5 and 6, where it is shown in the reverse position to Fig 2. The pieces D and E to which the levers G and F are pivoted, are connected by the wires 8 and 9 to the terminals of the armatures.

The contact jaw A is connected to the contact jaw B, by a wire at the back of the board. The current always enters on the wire 7 from the field coils, thence it passes through one or the other of the levers G or F, to the armatures by one of the wires 8 or 9 back on the other wire through the other lever to the ground connection, out on wire 10 to the ground.

The method of grounding wire 10 is fully shown by the wiring diagrams. In the position shown in the cut the current enters on wire 7 to the contact jaw B through lever F to the pivot E, through wire 9 to the armatures, back on wire 8 to the pivot D through lever G to the ground connection and out on wire 10 to the ground.

When the switch is reversed the lever G will be in contact with jaw A and lever F in contact with the ground connection and wire 10. In this position the current will enter on wire 7 to the contact jaw B, but this jaw not being in contact with the lever, the current passes through the wire at the back of the board to the contact jaw A, thence through the lever G to wire 8 through the armature in the opposite direction back on wire 9 through lever F to the ground contact, thence to the ground on wire 10. It is evident from the above that the wire 7 had at all times the full voltage of the line and that wire 10 makes connection with the ground.

Anything that will produce an arc across from either A or B to the ground connection will ground the line and result in the destruction of the switch. The same is true of the two points D and E. From this it is evident that two things are necessary for the preservation and proper working of the switch, viz.: 1st. That the insulation of the various parts be made and maintained perfect. 2nd. That the switch must never be moved or placed in such a position as to make an arc with either of the levers and the contact jaws.

MOTORS.

We have followed the path of the current from the trolley wire down to the motor. We have now to consider what takes place in the motors themselves. There are two different kinds of motors used on the lines of this company. The Sprague and T-H, or Thomson-Houston. Of the Sprague there is but one type. Of the T-H there are three types, viz. : Type 50 H. P., S. R. G., Type 30 H. P., S. R. G., and Type 30 H. P., D. R. G. Of the different types of the T-H the difference lies in the size of the wire and in the gearing only. The distinctive difference between the Sprague and the T-H is their field connections.

S. R. G. (single reduction gear) denotes one pair of gears.

D. R. G. (double reduction gear) denotes two pair of gears.

The two field coils of a T-H motor are in parallel with each other, while those of the Sprague are in series. Two wires or coils are said to be parallel when the current divides between the two and takes two separate paths after which it again unites. They are said to be in series when the current passes through one and then through the other. Fig. 3 is a perspective view of the T-H, S. R. G. motor, showing the wire connections. Wires (5 and 6) connect with the rheostat. Fig. 1. Wire (7) connects with the reversing switch.

As indicated by the arrows the current flows in on wires (5 or 6) and out on (7). This is true at all times. Wires (8 and 9) connect the armature terminals with the reversing switch as shown in Fig. 2. The current in these wires is flowing in one

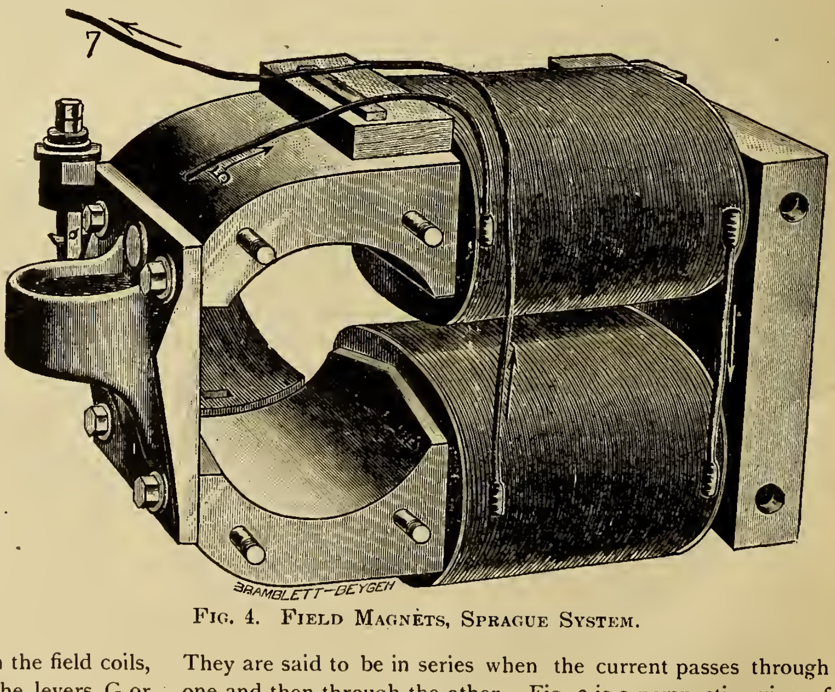

Fig. 4. Field Magnets, Sprague System.

direction when the motor is running in one way and in the opposite direction when the motor is running the other way. The current enters the armature on the wire that is toward the front of the car, in whichever way the car may be running.

In Fig. 3 the board shown at the side of the motor frame is known as the field board. It is made of two parts; one of which has grooves running up and down in which the wires are laid. The wires (5, 6 and 7) enter at the top and connect to three wires running up and down in the three parallel grooves. Wires (5, 6 and 7) connecting with the field coils, are connected with these wires. By this arrangement the wires (5, 5 and 5) are all connected together, also (6, 6 and 6) and (7, 7 and 7).

Thus the current entering on (5) in the direction indicated by the arrow passes down the wire on the inside of the block and divides between the upper and lower field coils, passing through the field coils and out on wires (7, 7) reuniting and thence to the reversing switch. Thus it will be seen that of the total amount of current passing one motor, only half passes each coil.

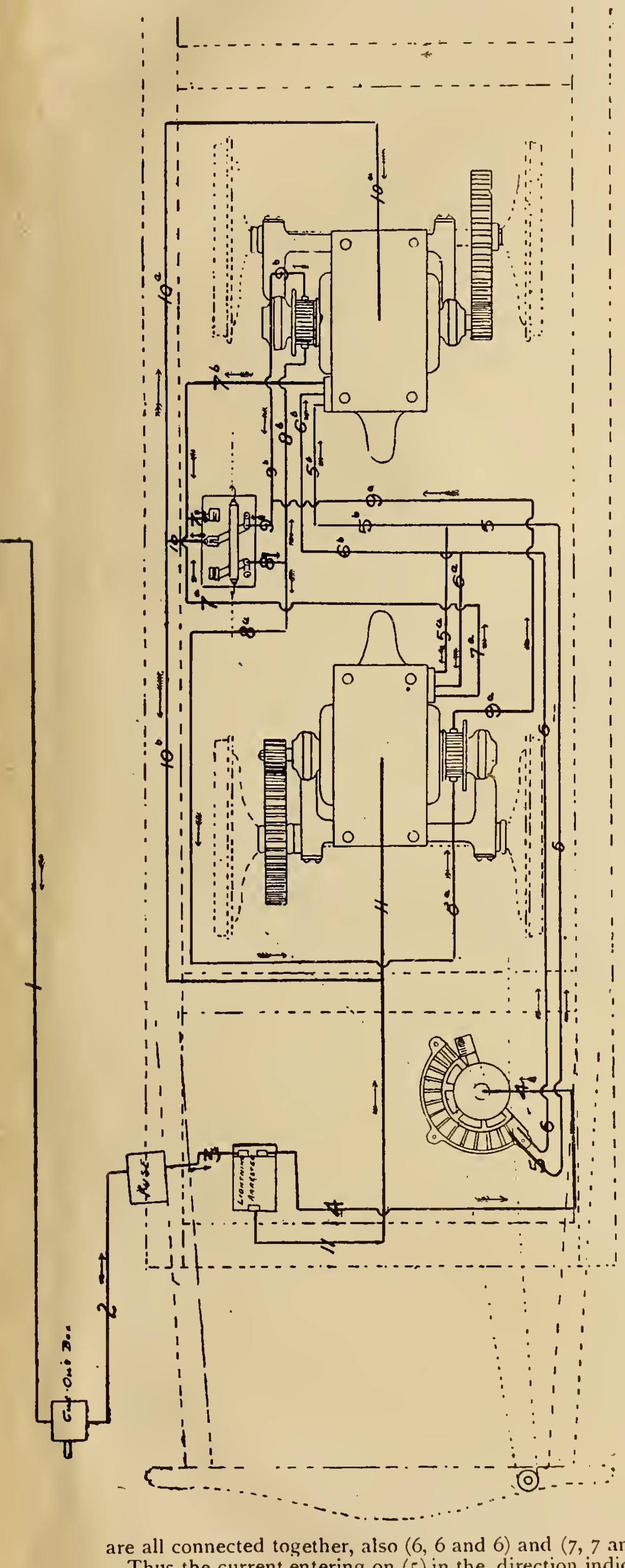

Fig. 5.—Diagram of Wiring Thomson-Houston Motor Car.—Single Reduction Gear.

When the rheostat is on the "loop" the current enters on wire (6), divides between wires (6 and 6) on the fields, passes through a portion of the field coils only, then out on wire (7) as before to the reversing switch. Returning from the reversing switch the current enters the armature on one of the wires (8 or 9) passes through the armature and out on the other wire, back to the reversing switch, thence to the ground.

The field wiring of a Sprague motor is shown in Fig. 4. The current enters on wire (5) passes into and through the upper field coil, thence down the connecting wire, as shown, into and through the lower coil, thence out on wire (7) as indicated by the arrow. From the field coils it flows to the reversing switch and back to the armatures in exactly the same manner as in the T-H motors.

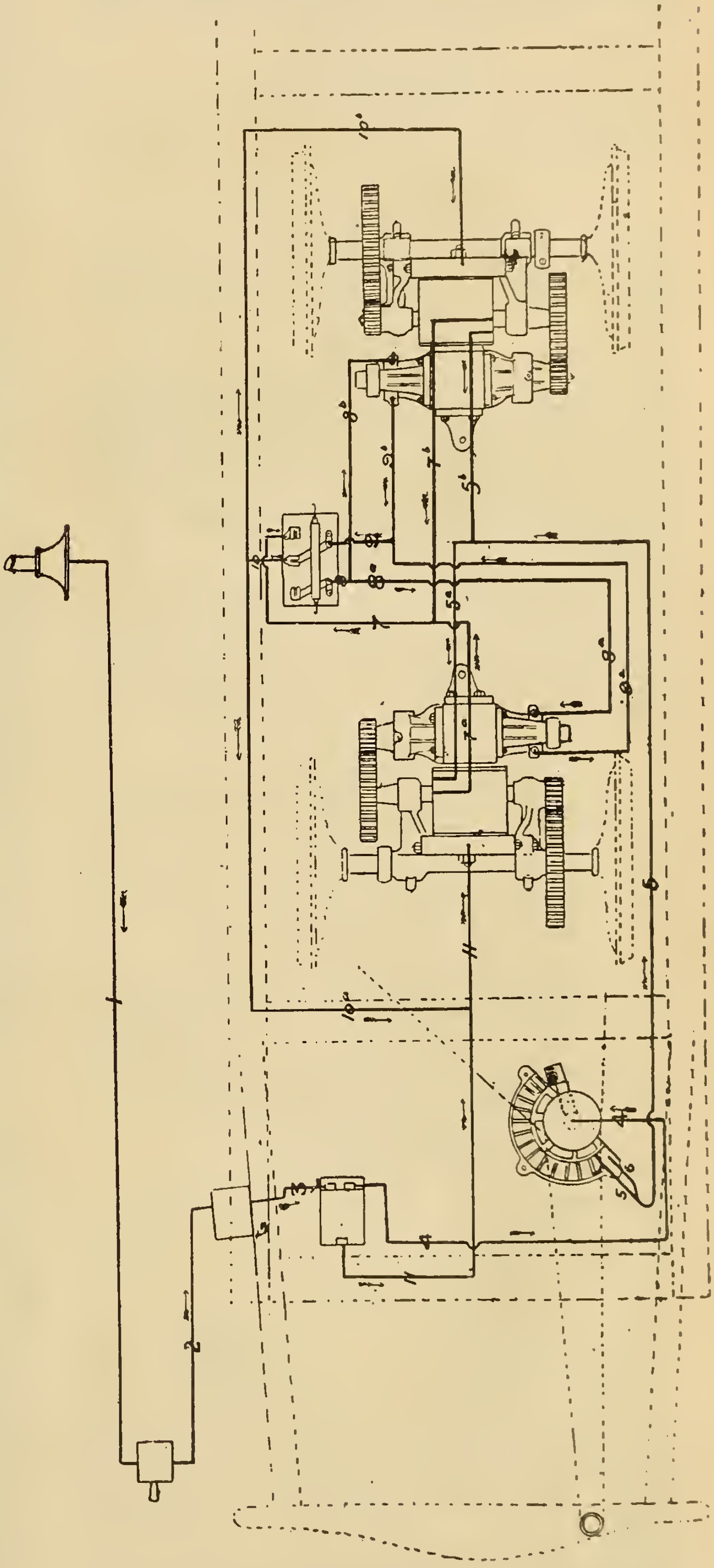

Fig. 6.—Diagram of Wiring Car for Sprague D. R. G. Motors.

It will be noticed that the principal electrical difference between the T-H and the Sprague motors is that the current divides between the field coils of the T-H motor, while it passes through the coils of the Sprague motor one after the other or in series.

Fig. 5 is a diagram showing the wiring of the T.-H. S. R. G. motor car with the loop connection. When the "loop" is left out it is simply disconnected at the motor and the two connections shunted together at the rheostat as shown in the diagram of the wiring of the Sprague motor car, Fig. 6.

(To be continued.)

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CHAS. H. MORTIMER,

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Correspondence is invited upon all topics coming legitimately within the scope of this journal.

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THE sixteenth convention of The National Electric Light Association of the United States, will be held in St. Louis, Mo., on February 28th, March 1st and 2nd.

CONSIDERABLE doubt exists regarding the relative advantages of high versus low speed engines in electric lighting stations. A number of inquiries have reached us on this subject. With a view to the elucidation of the question, we shall publish in several succeeding numbers of the ELECTRICAL NEWS a series of articles on the subject, and touching also upon the general character and arrangement of steam plant necessary to give the greatest efficiency of service at least cost of operation. We trust that these articles may prove of value to engine builders, owners and operators.

A HAMILTON company has applied for a charter to construct and operate electrical railways radiating from that city to other cities and towns in Western Ontario, and to lease and operate street railways in various municipalities. The idea with which the company was organized was that power to operate all these proposed undertakings could be generated at Niagara Falls and from thence transmitted by wire to Hamilton. As the result of having consulted Mr. W. T. Jennings, the well known engineer, the promoters learn to their disappointment that under present conditions the scheme cannot be worked on a paying basis, owing to the cost of the plant. This fact was stated in the ELECTRICAL NEWS more than a year ago in an article exposing the scheme to boom Queenston Heights as a manufacturing centre.

WHILE the electricity building at the World's Fair will probably afford too little accommodation for exhibitors of apparatus legitimately pertaining to the practical application of electricity, much space is being granted to what are known as "electrical fakes." The *Electrical Engineer* of New York enters a well founded protest against the admission of exhibits of this kind to the building, where they would appear on the same plane with those of legitimate character. The very fact that they are to be allowed to form part of the electrical display, will in the eyes of the public be regarded as evidence of their genuineness, and thus a deception which has already drawn from the pockets of the credulous vast sums of money, will be given a certificate of character by means of which the evil may be perpetuated. This condition of things, bad enough under any circumstances, when allowed to proceed at the expense of those desirous of making a satisfactory exhibit of apparatus of a legitimate character, becomes a grave injustice.

A CORRESPONDENT complains of the irregular admission of steam to an engine 12 inch, by 16 inch making 150 revolutions per minute. He says the steam is cut off for three and four strokes at a time, at quite regular intervals, and yet that he cannot detect any variation of speed. He does not give a very clear description of the kind of engine, but it would appear to be an automatic cut-off engine, probably with a spring governor controlling the position of the eccentric. If so, it might be quite possible that the speed of the engine increased sufficiently to move forward the cut-off arrangement and prevent the engine getting steam. It could not happen without some increase of speed unless the governor be so erratic in its action as not to control the engine at all. From our correspondent's statements we judge that the engine has too little to do for the size of cylinder and pressure of steam used. If the load on the engine is not to be increased, better results would be got by reducing the pressure. This is clearly a case where indicator diagrams should be taken, in order to determine what really does take place in the cylinder. Get the indicator to work, friend, and send along the diagrams, and we can then tell you better what to do.

ELECTRIC lighting companies who may be doing considerable house lighting by means of alternating system and converters, should select a central point of distribution in a block in which to locate if possible one converter to do all lighting required in such block. A much smaller converter capacity will thus be required than if every house was fed from its own converter, and as any good make of converter will carry a temporary overload of from 25 to 50 per cent., it will readily be seen that this method is surely a commendable one. As to the size required for such converter, a safe plan would be to have it of such capacity that it will be able to provide three lights out of every ten wired for. This would probably be all that would be required in the way of regular lights, but if four to every ten should be needed at times, the converter would be found to give them without any trouble, provided it were fused large enough to carry the temporary overload. In this connection we would advise even under ordinary requirements the fusing of all converters sufficiently large to carry double their rated capacity. There may be occasional cases where this rule would not apply, but in the general run it will be found to be about right. It might be argued that there might be a possibility of some one house in the block requiring all or nearly all of the lights in the house in use occasionally, but even in this case the rule would still apply, for we question if there are as a rule more than two and in many cases more than one light out of every ten in use in dwelling houses, unless at a special hour, and even then our three in ten would amply provide both for the house using nearly all their lights as well as the others.

THE world was startled some months since by the bold proposal to construct an electric railroad between Chicago and St. Louis, the trains on which would run at a speed of one hundred miles per hour. A company with a capital stock of seven million dollars was organized, and the work of construction commenced. Fifty thousand shares of the company are now being placed on the market, accompanied by what is termed a conservative estimate of the yearly revenue and expenditure. The revenue is estimated at $2,895,000, and the expenses, including interest charges, at $870,000, leaving the net earnings $2,025,000, or equivalent to a dividend of 29 per cent. on the capital stock. This at first glance might look like a good scheme to invest in, but on a closer view, presuming the estimated income to be properly based, $450,000 seems to be altogether too small a sum for operating expenses. Attention is also being drawn to the fact that even though it might be found practicable to construct apparatus which could be operated at such a high rate of speed —a subject on which there is the strongest reason for doubt— there has been no strong desire expressed by the public to be carried at such a rapid gait. There are already two or more railroads running parallel with the route of the proposed electric road, with which the traffic must be divided. It is likewise pointed out that if the new enterprise were likely to prove the bonanza which the promoters claim it will be, the existing railway corporations would be quick to perceive the fact and to buy up the stock. The scheme appears to be viewed with a good deal of suspicion, and the independent electrical press is fulfilling its duty by advising the public to be cautious about having anything to do with it.

THE dangerous and destructive influence of earth currents arising from the operation of the electric street railway has begun to attract attention in Toronto, as well as in Boston and elsewhere. A few days ago a spark was observed at the junction of the gas and water pipes in a knitting factory about a quarter of a mile distant from the Toronto Street Railway Company's power house. The current proved to be sufficiently strong to heat to a red heat a pair of pliers placed against the water pipe. An electrical expert to whom the occurrence was reported was inclined to regard it as a piece of imagination until he had satisfied himself of its truth by personal observation. There is no doubt that in this particular instance the building and its contents were in imminent danger of being burned up. How many other cases there are in which similar conditions prevail is a matter that has not been determined. It is but reasonable to suppose, however, that the case mentioned does not constitute a solitary exception. To the inequality of the grounds made use of is believed to be attributable the fact of certain pipes being so heavily charged. Whether or not means could be found of equalizing the grounds is at present a matter of speculation. It is rumored that new cables of the Bell Telephone Company's underground system are showing signs of decay as the result of electrolytic action due to these currents. In Boston, the underground gas and water mains are said to have been affected in like manner and from the same cause. If it should turn out to be true that earth currents are so destructive, street railway corporations will be compelled to do away with them by erecting additional overhead wires or by some other means. This is a subject of the greatest importance, and one which we should like to see discussed in all its bearings at the approaching convention of the Canadian Electrical Association.

ON the evening of Sunday, the 19th December, the people of London, Ont., were startled by a terrific noise and a shaking as if an earthquake had rushed past the city. Quite a number of windows had the glass broken, and some houses were invaded by pieces of iron or brass entering by way of the roof without ceremony. Next morning the public became aware that the disturbance had been caused by the explosion of a locomotive, which had been standing on a siding near the round house. The tender and fire-box part of the boiler were left on the track at one place, and a few feet away stood the truck supporting the cylinders of the engine and the front end of the boiler and the smoke pipe. Broken and bent boiler tubes and pieces of machinery and plates twisted into odd shapes lay between. The circular part of the boiler was gone. Nearly every window in the round house was broken and there was a piece of the brick wall about twenty feet long down. Only two men were hurt, and neither of these very badly. It is reported that one of these men was in the act of climbing up on the engine to look at the steam gauge when the explosion took place. It is a mystery that he escaped alive. The boiler must have had plenty of water in it, because the crown sheet of the fire-box was not damaged. Had the water been too low the crown sheet would have been the starting point of the explosion, and in all likelihood no other part of the boiler would have given way. The front end of the boiler shell looked to be about 4 feet in diameter and the pieces of plate scattered about appeared to be iron of good quality and to be about three eighths of an inch thick. The pressure must have been very great, and the plates would seem to have been of about equal strength, as all the round part of the boiler was blown to pieces. A good iron shell 48 inches diameter made of plates ⅜ inch thick and double rivetted would have a bursting pressure of about five hundred pounds per square inch. The fire box had screwed stays about 4½ inches centre to centre. and the plates seemed to be ⅜ inch thick. The bursting pressure of flat sides of fire box would be more than 1000 pounds per square inch. This is confirmed by the fact that when the round shell went to pieces the fire box remained quite sound. The engine had been standing on the siding to be ready for work on Monday morning with a little fire in it, as is the custom. It is apparent in this instance that the safety valves must have failed to relieve the pressure. The probability would be that the engine standing motionless all day and free from the usual shaking, the safety valves became fast in their seats and did not open at all. The steam space in a locomotive boiler is so very small that with no outlet for the steam a small fire would soon run the pressure up to the bursting point.

PERHAPS no part of a dynamo requires more care or attention than does the commutator if good running is the object aimed at. This not only applies to those commutators in which there are a number of segments, but particularly to those in which there are few, as a T-H Arc light dynamo, for in no one place can carelessness in cleaning or any neglect whatever result so disastrously as here. Of course in this make of dynamo the blower or blast producing mechanism becomes almost a part of the commutator, and requires the best of care and handling to produce the best results. We have known of cases where the screens that admit air into the blower have been so choked with dirt and oil that the only wonder was where the blower managed to get any air at all to deliver at the jets. The result was, flashing circuits and plenty of them, the cause of which seemed a mystery to the party who had the handling of the dynamos and who was supposed to look after and cure any tendency in this direction. As soon as the choked up screens were removed and replaced with new ones, the flashing at once vanished. Cleanliness and attention are as much a necessity with this part as oil is for the bearings. Then again to secure smooth running, the segments must not be allowed to become worn to any great extent, but when they become well marked with the track of the brushes should be replaced with others that are smooth and in good shape. The brushes must also be kept with an even smooth edge and not have too much bearing on the commutator—just enough being required to prevent them from jumping as the different sections of the commutator pass them. We have known cases where the brushes on a T-H arc dynamo were set with spring enough to exert a pressure of fully 25 lbs. (and perhaps more) on the commutator, at the end of each brush, and the wonder was expressed that the commutator segments wore away so fast at the end of each segment. The brushes being set as they should be, and new segments being put in place, the trouble was remedied at once, resulting in an almost even wear of the segments all around. These remarks do not apply to the many segmented commutators that are mostly used on non alternating incandescent dynamos and power generators, but even in these cases the greatest amount of care and attention is required at that part of the machine, it being necessary to go over them segment by segment occasionally to see if any of the mica insulation between the segment has worn out or become otherwise disturbed, leaving a slot that will fill up with carbon dust or copper from the brushes and cause a short circuiting of some of the segments. Another cause of trouble with this class of commutator will frequently be found in the dragging of a film of copper across the mica from one segment to the other, causing again short circuiting and trouble. We feel safe in asserting that there is no part of a dynamo that requires one quarter as much attention as the commutator does ; of course in alternating machines proper there is none of this trouble on account of the collector rings being in one piece all the way round, but even here care and attention used in keeping them flat and smooth will be more than repaid by the little trouble they will cause when so kept, not to speak of the uneven wearing of the collecting brushes when the rings are allowed to become serrated and lumpy.

APPARATUS for the production of heat by application of electric current has become a commercial article and has to a certain extent passed the experimental stage. Such apparatus is at present being made by several firms for the operation of tailors' irons and a variety of utensils for use in the household, such as griddles, stew-pans, coffee and tea pots, bed and bath room heaters, —in fact in some cases there have been offered for sale in the market heaters for either hot water coil heating or hot air. Perhaps the most surprising thing is that these heaters are reported as actually being operated at little or no cost above that of coal for the same purpose. Such reports however come from stations that are wholly operated by means of water power. This leads us to remark that owners or managers of light and power plants who have ample water in their dams all day long cannot employ it in a more remunerative way than to operate a dynamo or dynamos for this very purpose. Of course the current for such heating and cooking will have to be put down to rock bottom prices if the system is to be introduced, but it will still leave margin enough to pay a nice profit on the amount invested. Some of our readers after perusing the above may give more than a passing thought to the advisability or possibility of adding these heaters or cookers to their power generators or lighting circuits. In this respect there will have to be considerable judgment displayed, for while it would be possible to put any affair that would not require more than say 20 amperes on an ordinary lighting circuit, if wired heavily enough, it certainly would be detrimental to the lighting service to attach one that would require double that amount, unless a special wire was put in to feed it, as well as what might be used in producing lights. Again, with a power circuit, it would in most cases be an easy matter to put on an appliance consuming say current up to 50 amperes without disturbing the speed of any of the motors, but it might make quite an appreciable difference if 100 amperes were suddenly thrown on, unless, as mentioned above, special arrangements had been made to supply this amount of current at any one place by enlarging the mains and supply wires. Everything considered we feel that we are giving good advice when we say to station managers, take the matter up and ponder over it ; there will some good come of it, if you should happen to be one of the lucky possessors of a good water power and one that is available the whole year round. It would be absurd for us to advise the same course for those who are compelled to operate their plant by means of steam power, but it can be done in a small way, even under these conditions. Those who possess even enough water for condensing purposes can perhaps add a few small heaters or cookers to their power or lighting circuits to advantage ; at least the matter is worthy of consideration, and to those who care to give it some thought we heartily commend it.

500-VOLT MOTORS.

In most of our cities, motors are now run chiefly on 110 or 120 volt circuits, a few being found also on arc series circuits. There appears to be, however, says the *Electrical Engineer*, a marked tendency towards the use of constant potential motors, at as high a voltage as 500, not merely on railway circuits, but in regular power work. Mr. A. C. Balch, the electrical engineer of the Union Power Company of Portland, Ore., writes us that they now have in operation something over 700 h. p. of 500-volt motors. It would, he remarks, be a financial impossibility to run at any lower voltage, as the station is three miles from the centre of distribution. The 500-volt machines have given little, if any, extra trouble, as compared with the 110 or 220 volt motors.

This is interesting and encouraging, and is confirmed by the reports that reach us from another large city, where about 850 h. p. nominal is now being furnished with 500-volt motors, averaging 7½ to 10 h. p., and going up to 35 h. p. In this case the station is about midway in a system of distribution stretching 5 miles, or about 2½ miles each side of it. The demand is growing, and the motors will reach 1,000 h. p. daily this year. As overhead circuits are used, the extensions of the service are made quickly and economically. Current is metered, and also sold at a flat rate, but prices, so far as we can learn, average four or five cents per horse power hour, and perhaps shade below that for large powers, running, however, well up to ten cents for small powers.

We think the field here indicated is worthy of study by station managers. Motors of high voltage are now well built, and even in the smallest sizes are capable of yielding excellent results ; while the saving of copper in the circuits is something enormous. But perhaps we shall not see the full possible development of this field until a higher volt incandescent lamp also makes its successful debut. Meantime, in planning independent power circuits, managers should, we think, concentrate their energies and attention on 500-volt work, as being safe for the public, as more economical for themselves, and as admitting of the distribution of power over a much larger territory.

WIDTH OF BELTING.

How to find out what width of belt to get often bothers millwrights and power users ; and sometimes they make great mistakes, getting belts that are much too narrow to do the work that is demanded of them, or else paying for belts and pulleys which are much too wide for the power that they have to carry. Leather belts are the most used, and they are used more on cast iron than on any other kind ; and the following rules apply to these conditions. We will assume that the belts are 7/32 inch thick, and in good condition. Of course the width demanded depends in great measure upon the mode of fastening employed; for the belt itself will not carry any more strain than the lacing or other fastening will. This table will be found practically correct for the conditions named ; and for an arc of contact of 180° on the pulley ; that is, where the belt wraps half way round the pulley :—

For single leather lacing, the width of belt in inches is 0.0197 times the pull needed upon the pulley to carry the power at the speed at which the belt is running. For single rawhide lacing, 0.0183 times ; double leather, 0.0171 ; double rawhide, 0.0160 ; for riveted joints, 0.0111 times.

The number of pounds pull required to carry any number of horse power, at any speed per minute, is found by multiplying the number of horsepower by 33,000, and dividing by the speed in feet per minute. Thus suppose it be required to carry 290 horse power at 2700 feet belt speed, by a leather belt 7/32 inch thick, running on a cast iron pulley upon which it wraps 180°, the lacing being single leather ; then the pull will be $290 \times 33{,}000 \div 2700 = 354.4$ pounds. The belt width in inches will be $354.4 \times 0.0197 = 7.02$, or practically 7 inches.

If the belt was laced with double rawhide, then the width required would be only $354.4 \times 0.0111 = 3.93$ or practically 4 inches. —*Power and Transmission.*

THE COST OF ELECTRIC SUPPLY.*

By Dr. John Hopkinson, F.R.S.

Electrical engineers now realize that they have to provide the same plant and no more to give a steady supply day and night, as to give a supply for one hour out of the twenty-four. They also now realize that if they are to be ready to give a supply at any moment, they must burn much coal and pay much wages for however short a time the supply is actually taken. Indeed, the term "load-factor" proposed by Mr. Crompton is as constantly in the mouths of those who are interested in the supply of electricity, as volt or ampere or horse-power. The importance of the time during which a supply of electricity is used was so strongly impressed on my mind years ago, that in 1883 I had introduced into the provisional orders with which I had to do, a special method of charge intended to secure some approach to proportionality of charge to cost of supply. Unfortunately the orders of that day all came to nought.

A supply of electricity must be delivered at the very moment when the consumer chooses to use it, and as long as and no longer than he pleases to use it; it cannot be very readily or cheaply stored, and much of the cost of production is the fixed charge for plant and conductors. Furthermore, the provisional orders require that the supply shall be available at all hours; hence coal must be consumed and workmen must attend, though but few customers are drawing a supply. The service of supplying electricity has from an economic point of view a great deal of similarity to the service of providing a breakwater for a harbour. A great deal of the expense is independent of the number of hours in the day during which the supply is used. To put it in another way, the cost of supplying electricity for 1,000 lamps for ten hours is very much less than ten times the cost of supplying the same 1,000 lamps for one hour, particularly if it is incumbent on the undertaker to be ready with a supply at any moment that it is required.

The actual importance of considerations of this kind can only be realized by examining figures. The figures may as well be estimated figures, because the circumstances vary from one neighborhood to another. No criticism of the details of the figures will affect the general character of the conclusion. Let us then imagine a station capable of supplying 40,000 16-candle lamps at one time, with mains and spare machinery enough to ensure that the supply shall not fail, and let us see what the charge for running such a station will be; firstly, on the hypothesis that it is always to be ready to supply the 40,000 lights at half-an-hour's notice, day or night, but the lights are hardly ever actually required; secondly, on the hypothesis that the 40,000 lights are steadily and continuously supplied day and night. These are the two extreme cases possible. In the former, the load factor is nil; in the latter it is 100 per cent. If the charge is by meter at 8d. per unit in the former case, the revenue will be nil; in the latter it will be £730,000 a year.

We are going to divide the cost of supplying electricity into two parts: a part which is independent of the hours the supply is used, and a part which is directly proportional thereto; and we are going to estimate the amount of each element. It is for the purpose of ascertaining these elements that we consider two quite hypothetical cases; cases which can themselves never actually occur.

We must first have an idea of the capital outlay required. To provide the maximum of 40,000 lamps we need to deliver 2,500 units per hour, and we may estimate the capital outlay as follows:

Land	£25,000
Buildings	15,000
Boilers and pipes	14,000
Engines	24,000
Dynamos	15,000
Switchboard and instruments	2,000
Feeders and mains	50,000
	£145,000

Let us deal with the annual charge for each item of capital separately on the two hypotheses. The charge for land and for buildings, including repairs, is clearly the same in the two cases, say at 4 per cent. £1,000 for the land, and at 10 per cent. £1,500 for the buildings. The boilers, engines and dynamos will have a charge for interest and a charge for writing off, or amortisation as the French call it, that is, for writing off the value of the plant before the time at which it becomes antiquated—exactly the same in the two cases. The boilers too will require exactly the same repairs whether they are merely keeping steam or whether they are generating steam continuously; but the machinery will certainly require more for repairs and renewals if it is all running than if a part only is running without load and the rest is standing ready for a load if required. I take 4 per cent. as the charge for interest; 3 per cent. for amortisation; 8 per cent. for repairs and maintenance. Of the repairs of engines and dynamos I assume that 2 per cent. will be applicable if the plant runs light, the remaining 6 per cent. if it is fully and continuously loaded. The expenses connected with conductors, switchboard, etc., will be exactly the same whether the current is passing or not; these I take at 15 per cent. The rates I put down at £500 a year. The account then for the fixed charges already enumerated would stand as follows:

	Running light.	Fully loaded.
Land	£1,000	£1,000
Buildings	1,500	1,500
Rates	500	500
Boilers	2,100	2,100
Switchboard and conductors	7,800	7,800
Engines	2,160	3,600
Dynamos	1,350	2,250
	£16,410	£18,750

We now come to a most important item in the account, the coal. There is no doubt that with uniform and continuous load a unit of electric energy—1⅓ horse-power for one hour—can be produced for less than 3 lbs. of coal; it is also pretty much admitted that with a load factor of about 12 per cent., but continuous maintenance of pressure, the consumption of coal in good practice is something like 7 lbs. That is to say to keep the boilers warm, turn round the machinery for 24 hours, and deliver full current for 24 hours, will require 72 lbs. of coal per kilowatt; whereas, to keep the boilers warm, turn round the machinery, and deliver current for three hours, will require 21 lbs. of coal. The boilers being kept warm, it will take 51 lbs. of coal to generate steam enough to give a unit per hour for 21 hours; 58 lbs. to give a unit per hour for 24 hours; subtracting this from 72 lbs., the amount required both to generate steam and keep the boiler warm, we may infer that to keep the boiler warm and merely turn the machinery in readiness to meet a demand will take about 14 lbs. of coal per day for every unit per hour the plant is capable of producing. In 1889, for the Society of Arts, tests were made of a Paxman compound engine, from which it appears that a boiler which, when fully loaded, consumed 40 lbs. of coal per hour, required 4 lbs. per hour to keep steam up to normal pressure when the engine was standing; that is, 10 per cent. of the coal used was used to maintain the steam pressure. Remembering that in addition we keep some of our machinery moving, this may be said to confirm the figures adopted. Thus, if the plant runs light all the year round 12,775,000 lbs., or let us say 6,000 tons of coal will be consumed. If the plant runs fully loaded 65,700,000 lbs., or let us say 30,000 tons would be consumed. If we suppose the coal to be the best smokeless it might cost 20s per ton. Next we have water, oil and petty stores; say £600 and £3,000 in the two cases. Wages will be a little less if we run light than if we run fully loaded, and of course will largely depend on local circumstances; let us say £5,000 and £7,500 in the two cases. This gives us substantially all the expenses which have to to be met, and our account will then stand thus:—

	Running light.	Fully loaded.
Fixed charges	£16,410	£18,750
Coal	6,000	30,000
Stores	600	3,000
Wages	5,000	7,500
	£28,010	£59,250

Thus the cost of merely being ready to supply 2,500 units per hour at any moment throughout the year will be £28,010, and the cost of actually supplying 2,500 units per hour for every minute in the year will be £59,250. The undertaker, therefore, who incurs the liability to supply, ought to receive £11 per annum per unit per hour from those on whose behalf he incurs the liability, and if he receives the £11 he need not charge more than 1/3d. per unit for what he actually supplies, to cover his expenses. That these figures are fair approximations can be seen as follows: According to this calculation the cost of supplying 2,500 units for one hour per day is £28,010 + 2,500 × 365 × 1/3d. = £29,277, and the charge for the service at 8d. a unit would be £30,417; it is doubtful if such a supply would pay. On the other hand an indicated horse-power on such a scale could certainly be supplied continuously for from £12 to £14 per annum, and according to this calculation an electrical horse-power will cost just under £18 per annum. No account is taken of expenses peculiar to companies, such as directors' fees and the cost of forming the company. It will also be noted that it is assumed that accumulators are not used.

The charge for a service rendered should bear some relation to the cost of rendering it. If it is a matter of open competition the matter will settle itself, for no one will for long be able to supply some customers at a loss, and recoup himself by exorbitant profits from others. If the matter be a case more or less of monopoly, the adjustment is less certain; thus the Post Office charges ½d. postage for a printed circular and 1d. for a written letter, the two costing the Post Office exactly the same. What a boon to the public it would be, if the Post Office would charge more for printed trade circulars, which in nine cases out of ten are a nuisance to those who receive them. The supply of electricity is not quite a monopoly; companies compete with each other, and there is always the competition with other methods of illumination such as gas and paraffin. It is clearly to the advantage of the undertaker to secure all those customers whom it pays best to supply, and as far as may be, to compel those who are unrenumerative to adopt these other methods. The ideal method of charge then is a fixed charge per quarter proportioned to the greatest rate of supply the consumer will ever take, and a charge by meter for the actual consumption. Such a method I urged in 1883 and obtained the introduction into certain provisional orders of a clause sanctioning "a charge which is calculated partly by the quantity of energy contained in the supply, and partly by a yearly or other rental depending upon the maximum strength of the current required to be supplied." In fixing the rates of fixed charge it must not be forgotten that it is improbable that all consumers will demand the maximum supply at the same moment, and consequently the fixed charge named might be reduced or some profit be obtained from it. There is no object in reducing the cost of electricity for lighting in the case of any customer much below the cost of equivalent lighting by gas, unless there are competitors in the field willing to do it, hence the current charge proportioned to the power supplied may safely be increased. In certain recent cases in which I am acting as engineer, the Board of Trade have sanctioned, on my application, "for each unit per hour in the maximum power demanded, a charge not exceeding £3 per quarter, and in addition for each unit supplied, a charge not exceeding two-pence." It is sometimes said as an objection to this method of charge, the public will object to paying a fixed charge whether they make use of their lights or not, and that in fact they will not pay it. The best answer that can be made is to give everyone the choice of being charged the maximum simple rate provided by the order, or by the compound rate as they prefer. What is wanted is not so much an increased charge for those consumers whose lights are used for a short time, as such a special reduced charge for those whose lights are used long as will induce them to use the supply.

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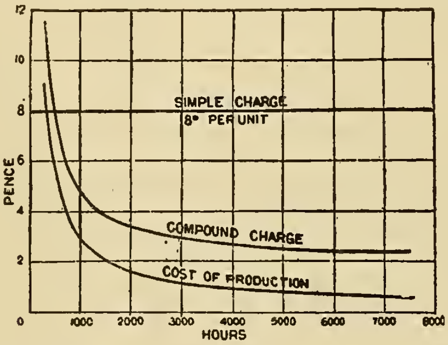
* Presidential Address to the members of the Junior Engineering Society, delivered November 4th, 1892.

It is instructive to compare the cost to different classes of consumers of electricity and gas for lighting with 16 candle gas. Flat flame burners must be large and of first rate quality to give mere than two candles per cubic foot of gas per hour; the large majority of burners give much less than this even at their best, and, as a rule, the pressure of gas is not regulated, and much gas is wasted as far as the production of light is concerned. Incandescent lamps give about one-quarter of a candle per watt; hence a Board of Trade unit is equivalent to 125 cubic feet of gas. Thus we readily arrived at the following comparative table, the charge being at the rates recently sanctioned by the Board of Trade :—

Hours of use per annum.	Load factor.	Price of gas at which cost of lighting by electricity and 16-candle gas are equal.
480	5·5	5s. 4d.
960	10·9	3s. 4d.
1,440	16·4	2s. 8d.
1,920	21·9	2s. 4d.
2,880	32·9	2s. 0d.
3,840	43·8	1s. 10d.
7,680	87·6	1s. 7d.

In the accompanying curves are shown the cost of production, and the charge per unit at the compound and simple rate. The ordinates represent pence, and the abscissæ the number of hours per annum the supply is used.



It is obvious that those whose user is long will find the electric light economical to themselves, and that it will be profitable to the undertaker. With a cheap light which is free from the products of combustion there will be extensions for the hours of use. Shops may find it worth while to continue the light after closing, as an advertisement.

We have so far assumed that the supply of electricity is carried on without the aid of accumulators. Let us first compare the cost of an electric accumulator with the cost of a gas-holder containing the same possibility of producing light. A gas-holder is at present being put up in Manchester to hold 7,000,000 cubic feet of gas, and is to cost, complete with its tank, £60,000. With 16-candle gas, seven million cubic feet are equivalent to 56,000 Board of Trade units. Accumulators capable of storing a ten hours' supply, cost about £50 per unit. The equivalent accumulator will, therefore, cost about £280,000. But this is not all; the gas-holder is comparatively permanent; the accumulators require frequent renewals and repairs; the gas-holder gives back all the energy put into it; the accumulators waste at least 20 per cent.; the gas holder may be emptied as fast as you please; the accumulators, not faster than a certain rate without diminishing their capacity. Taking all into consideration, the cost of storing energy by the aid of accumulators, and storing it in a gas-holder are quantities of a different order of magnitude. If no gas-holders were used, and all the gas had to he made just as it was wanted, its cost for lighting would be several fold what it now is, even if gas producers could be found capable of instantly varying the supply as the demand varies. The gas-producing plant would have to be enormously increased; so would the size of the mains, and so would the wages of labour. If electric power could be stored as cheaply as gas, there would soon be little hope that the gas companies would maintain their dividends.

Let us see from a financial point of view whether accumulators can be used economically for storing up electrical power continuously produced during the 24 hours, and used rapidly for a short time.

Assume that the whole of the plant with the accumulators is capable of supplying 40,000 lights for ten hours continuously, and that during that time half the power is supplied from the accumulators. Ten hours in the twenty-four hours is not an unreasonable allowance, for we have melancholy experience in London of continuous fogs for days, and this would tax the plant we are considering to the utmost. We are to be ready then any time on short notice to supply 40,000 lights, and to continue to supply them for ten hours. Compare the cost, firstly, of maintaining this state of readiness with the accumulators and with a plant without accumulators. We shall require a battery capable of giving 1250 units for ten hours; such a battery costs not less than £50 per unit, or in all £62,500. To maintain it will cost from 10 to 15 per cent. on the cost; there will also be interest on the outlay and amortisation, say in all 20 per cent or £12,500 a year. If we assume that the batteries are distributed at the various points of the system of conductors, we may also assume that the charges for land and buildings will be much the same as for the plant without accumulators. The boilers, engines and dynamos will be just one-half. The switchboard and instruments will be much the same. But the conductors will be reduced, smaller or shorter feeders being necessary, probably £40.000 will go as far with accumulators as £50,000 without. The coal bill may be dispensed with entirely, as we may assume that steam could always be got up during the time in which the demand increased from nothing to one half of the maximum, and that therefore all the coal burned can be assumed to be burned for producing current. That is to say, we assume the quantity of coal burned is proportional to the quantity of electric energy, and that therefore when no electricity is actually used, no coal will be burned. The wages may be reduced, for we have only to be ready to run half the plant, and a small wage will suffice for attendance on the accumulators. The wages of linesmen and the like will remain the same. Assume the total wages to be £3,500 instead of £5,000. The account will then stand thus :—

Land	£1,000
Buildings	1,500
Rates	500
Accumulators	12,500
Boilers	1,050
Engines	1,080
Dynamos	675
Switchboard	300
Conductors	6,000
Wages	3,550
	£28,105

practically the same result as we obtained before.

Now consider another hypothetical case, which of course can never occur in practice. We are to supply 40,000 lamps for 10 hours every day with the plant just described, charging the accumulators during 12½ of the 14 hours during which the lights is not required, 12½ hours charging giving 10 hours discharge of the same energy. The coal would cost the half of £30,000 if the machinery had to run the whole of the 24 hours. It has to run 22½ hours, but the boilers have to be kept warm the whole time, hence the coal will cost the half of £6,000 for keeping the boilers warm, and 22½-24 of the half of £24,000 for generating steam. The wages may fairly be taken as £4,750, and the account will stand:

Land	£1,000
Buildings	1,500
Rates	500
Accumulators	12,500
Boilers	1,050
Engines	1,800
Dynamos	1,125
Switchboard	300
Conductors	6,000
Wages	4,750
Coal	14,250
Stores	1,425
	£46,200

The cost of supply for the same 10 hours without accumulators would be as follows:—

Land	£1,000
Buildings	1,500
Rates	500
Boilers	2,100
Switchboard and Conductors	7,800
Engines	2,760
Dynamos	1,725
Coal	16,000
Stores	1,600
Wages	6,000
	£40,985

a cost of about 11 per cent, less than where accumulators are used.

Putting it another way, the cost of being ready to supply and to continue to supply, is about the same whether accumulators are used or not; the additional cost of actually supplying current is about 40 per cent, more where accumulators are used than where they are not used. It may be safely inferred that the use of accumulators does not seriously alter the conclusions I have drawn as to the proper method of charging consumers for a supply of electricity.

The question of whether the great cost of a supply for short hours can be removed by the use of accumulators, may be looked at in another way. Will it pay a consumer to put in his own accumulators and charge them from the station supply? We may reasonably suppose the undertaker will remit the fixed charge in consideration of the consumer only taking his current at slack times. His accumulators, if they are to be of capacity to maintain his supply through a foggy day, will cost him £50 per unit per hour (or per kilowatt) and the annual charge in respect of them will be £10 per year, to which, if we add a rent for the space the battery occupies, gives us a charge not differing materially from the fixed charge made or suitable to be made by the undertaker. But in order to obtain 2d. worth of electricity he must purchase 2½d. worth for charging his battery.

A word or two more about the use of accumulators. These have certainly improved, and they will continue to improve. They will become more durable and more economical of power in working, and their first cost will become less. An inspection of my tables of cost shows that a very little improvement would render them valuable even in very large stations for the mere purpose of diminishing the machinery required, by storing the energy developed at slack times to be used in busy times. The certainty of improvements in accumulators, and the possibility that the improvement may be considerable, is a strong argument for the use of the direct current, wherever it is not precluded by the distance of transmission being too great.

It will be noted that I have assumed a very large station. Accumulators have another use which greatly increases their advantage in smaller stations. There are many hours in the twenty-four when it is absolutely certain that the demand will be small. If accumulators are used the attendance of the staff may be dispensed with during those hours, and a considerable sum in wages will be saved. The proportion of wages to the whole charges is much greater in small stations than in large. In most small stations giving continuous supply, accumulators ought to be used notwithstanding their expenses and defects, and I believe the day is not far distant when they ought to be used in connection with most large stations also.

If instead of a continuous current, an alternating current with transformers will have to be added. If the distances are small, the increased cost of transformers will exceed the saving in the conductors; if the distances are considerable, the cost of transformers will be less than the saving of conductors. In both cases the general character of the result will be the same as before, the cost of being prepared to give a supply will be considerable, and the cost of actually giving the supply will be much smaller than is generally supposed. Indeed, with the alternating current this peculiarity will be even more marked, for the machinery has not only to be kept in motion, however small the consumption may be, but a certain current must be maintained in every transformer. With the best transformers, this current may only have an energy 1½ per cent, of the energy of the current when the transformer is fully loaded. This would increase the coal bill in the case cousidered by about £500 per year, whether the supply was used or not.

It is possible; indeed probable, that some of my assumed figures may be shown to be too high or too low for the generality of cases. It is of no moment; let each one take any figures he pleases, within reason; let him assume that the supply of electricity is made by any system he pleases; he will arrive at a result broadly similar to mine. To be ready to supply a customer with electricity at any moment he wants it, will cost those giving the supply not much less than £11 per annum for every kilowatt, that is for every unit per hour, which the customer can take, if he wishes, and afterwards to actually give the supply, will not cost very much more than ⅓d per unit. This is the point I have been labouring to impress, for I take it, it is essential to the commercial success of electric supply. It is hopeless for electricity to compete with gas in this country all along the line, if price is the only consideration. But with selected customers, electricity is cheaper than gas. Surely it is the interest of those who supply electricity to secure such customers by charging them a rate having some sort of relation to the cost of supplying them.

HOW STEAM ACTS IN AN ENGINE.

Probably the majority of engineers would like to know how the steam acts in the cylinder of their engine, whether it flows in and moves the piston by a steady push like a solid column, or whether there is a turmoil and excitement inside the cylinder. Much has been said about condensation of the entering steam on the cold surface of the cylinder, and, as the piston moves, the presenting of new and cold surfaces. It has been claimed that a thin film of steam around the outside of the mass of steam became condensed, but that the interior of the column was comparatively dry. An English engineer has been trying some experiments to prove these matters, and they are certainly interesting if they are not conclusive. The problem was to look at the interior of the cylinder, but as a glass cylinder could not be maintained intact, with a movable piston in it, some other means must be tried. A large engine was selected, about fifty revolutions per minute, and near it was set up a glass cylinder. This cylinder was provided with steam and an exhaust valve, but had no piston working in it. The valves wese connected with the valves of the engine and admitted steam to the glass cylinder and cut off the supply at the same time as in the cylinder of the engine, and exhausted the steam at the end of the engine stroke. When the steam valve opened on the engine it opened to the glass cylinder and completely filled this glass cylinder with steam. It was just as though the glass cylinder had been attached to the head of the engine cylinder. It would then be a part of the engine clearance, and any action that might take place in this glass cylinder might be taken as showing the action of steam in the clearance space of the engine. There are facilities for superheating the steam entering this glass cylinder, and also for condensing the exhaust from it. The steam is admitted to this cylinder, and there is, of course, no difficulty in watching the phenomena, which is described in English engineering journals. The steam enters in the centre of the upper end of the cylinder, and a minute's observation suffices to dispose of the idea that thin uniform films of moisture accumulate on the cylinder walls. On the contrary, we see that a species of hurricane rages within the cylinder. The moment the steam valve opens there is an in-rush which blows all the water remaining in the cylinder in every direction. The interior of the cylinder is filled with a storm-tossed cloud. Water quickly deposits itself in big drops on the glass, some of which drops run down to the bottom. The exhaust opens and the clouds disappear like magic; violent ebullitions take place and a good deal of water disappears, and so the process is continued stroke by stroke. The first point almost to strike the observer is that under no circumstances do the surfaces inside the cylinder become wholly dry. Condensation and ebullition take place alternately, but there are always drops of water on the glass and metallic surfaces. These neither increase nor diminish in quantity. So far we have spoken of nothing more than might be expected to happen. But the matter does not end here. To begin with, it might be supposed that the presence or absence of a vacuum would greatly influence the results. But this does not appear to be the case. The ebullition which goes on when the exhaust opens is more pronounced, but so far as can be seen the formation of cloud and the deposit of water in drops on the cylinder walls is about the same in both cases. Again, it might be concluded that by super-heating the steam condensation would be wholly averted. Nothing of the kind. It is diminished, but not entirely got rid of; and yet it is very puzzling to understand how and why condensation can take place when the steam contains so large a reserve of heat. The glass cylinder is fitted with a small indicator, by the aid of which diagrams may be taken in the usual way. These are shown in Figs. 1, 2 and 3. At first sight they might easily be taken for ordinary engine-indicator diagrams, but this is a mere coincidence. There is no expansion curve for the steam fills the glass cylinder at the start. The length of the card is the engine stroke reduced. Steam is admitted, and as the valve remains open, the condensation is all made up through the open valve, but at A the engine cuts off the supply to this cylinder, and any further condensation would cause a loss in pressure. If no further condensation occurred then the line B A would be prolonged as dotted. The pressure falls, however, the instant cut off takes place and goes on falling to about half the initial pressure. The curves are not expansion, but condensation. It would be fair to assume that the cylinder had been thoroughly heated during the admission period, so no further condensation would occur, but such is not the case. It shows that in that short time the walls of this cylinder were not heated entirely during the admission period, but continued to demand heat long after cut-off, or else that condensation may ensue from some other cause.

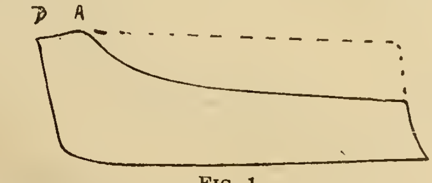


FIG. 1.

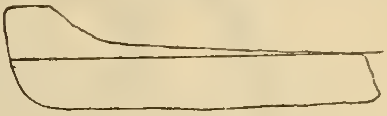


FIG. 2.

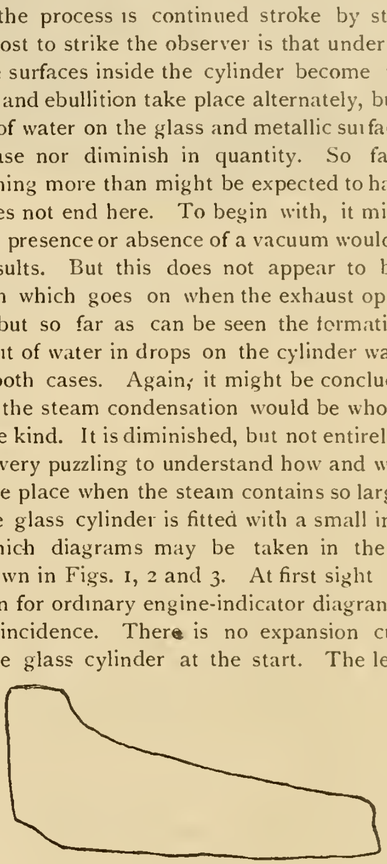


FIG. 3.

Fig. 2 was taken when the cylinder was worked condensing, and Fig. 3 with superheated steam and condenser. The superheating of the steam does not seem to have prevented the loss in pressure, but it required less steam than the others. The experiment would seem to indicate that in a steam engine, the steam is in violent commotion at all times and that with expanding steam following a quick receding piston, and continuously opening up new surfaces of comparatively new cold iron, that condensation is going on at all times down to the point re-evaporation commences, and that the cylinder walls are never heated enough to reach a point that they will not extract heat from the steam until it has expanded to a low temperature. The deductions of the eminent engineer who is making the experiments will be awaited with interest.—*Boston Journal of Commerce.*

L. P. & D. SYSTEM OF DRIVING DYNAMOS.

By W. W. Nugent, Chicago, Ill.

THE practice of enclosing machinery in confined spaces has made some new system of transmitting power from engines to machines necessary. Numerous devices have been tried for this purpose, all of which have been more or less successful, but many of those, which have been put in extensive practical operation have not wholly complied with the requirements, for they have left other things to be desired.

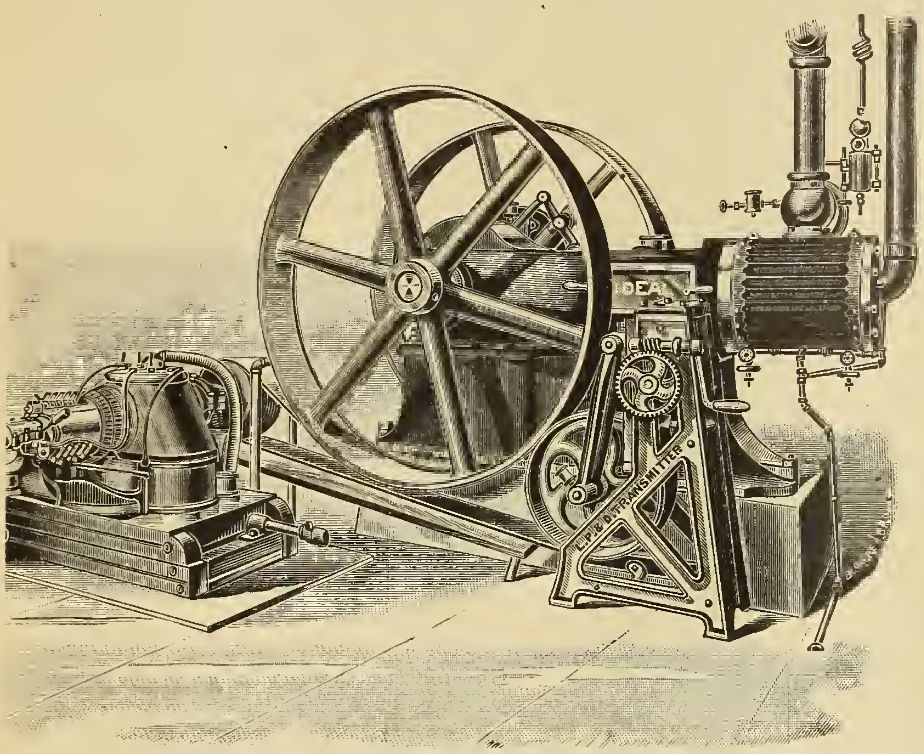


Fig 1.—The L. P. D. System of Driving Dynamos.

The accompanying illustration clearly shows the L. P. & D. system, which has been found to operate most satisfactorily under all conditions where a similar method of transmission would be required. The first illustration represents this method applied in the Siegel & Cooper electric installation, Chicago. The dynamo is a 400 light incandescent Western Electric machine driven by an Ideal high speed engine, having a 72″ driving pulley. A light double leather belt, 19′ long and 8′ wide is, employed. The space between the dynamo and engine pulley is 6″, while the whole space occupied by dynamo, engine and transmitter is 8′x11′.

It will be seen that but very little space is required in transmitting the power from driving to the driven pulleys. Where space is limited, this device becomes most valuable, for the whole plant is made quite compact and the arrangement is most convenient. If more space can be conveniently employed, a longer belt can be used, but there is no particular gain in the use of long belts.

Among the numerous methods for transmitting power from engine to dynamo, belting is conceded to be superior, as it is less injurious on the bearings of the machine. By the use of transmission the bearings are relieved of a great deal of the strain that would otherwise be necessary, for the belt does, in all cases, encircle more than one half the circumference of the driven pulley, while the contact of the belt with driving pulley, gives at all times a greater surface in contact than is employed on the driven pulley; consequently the strain is less than as though longer belts, running direct from driving to driven pulley were employed. From being in contact with the under side of of the driving pulley, the belt carries a portion of the weight of shaft and pulleys that would otherwise rest on the bearings, thus relieving them of a portion of the friction that would result from other methods of transmitting power.

It will be seen that the driven machinery, whether dynamo or other device, can be readily stopped or started without in any way changing the speed of the engine, for the pulley on the transmitter is capable of being raised or lowered by the feed screw, fitted with crank as shown in the illustration. By lowering the pulley of the transmitter, the belt is thrown out of contact with the driving pulley and the machine comes to rest. When in position, the belt can be readily removed from the pulley of the machine, or put in position and the machine started by raising the pulley of the transmitter.

The device is most simple and complete, and is applicable in many ways to various kinds of plants. It may also be applied to the pulleys of jack shafts, and by its use a large number of machines can be operated on small floor space as shown in Fig. 2. The use of short belts makes this possible, as the machines can be brought as close as desired to the driving pulleys, and pulleys can be placed as close together on the jack shaft as required. The other machines can be placed at a convenient distance to give the necessary room for conveniently getting around the machines to do such work as is required.

Fig. 3 clearly shows the principles of the system in outline. From this drawing it will be seen that the length of belt in contact with the driving pulley is greater than that in contact with the driven pulley, while the contact on the driven pulley is greater than is found in the more common systems of belt transmission. This system is easily applied to any existing plant, for all that is necessary is to fasten the transmitter so that its pulley will be about 2″ from the floor and ½″ from the driving pulley. The pulley of the driving machine should be placed as near the driving pulley as possible and a line drawn from the under side of this pulley to the lower side of transmitter pulley should pass about 2″ from the bottom of the driving pulley on engine or shaft. If the dynamo or other machine is mounted on a base in such a manner that it may be moved, the same purpose may be served as though the transmitter pulley was moved. The use of this device, will in some cases, increase the driving power, because a greater contact between the belt and driven pulley can always be obtained and the contact of belt upon the driver will still be greater than that upon the driven pulley, so that in case

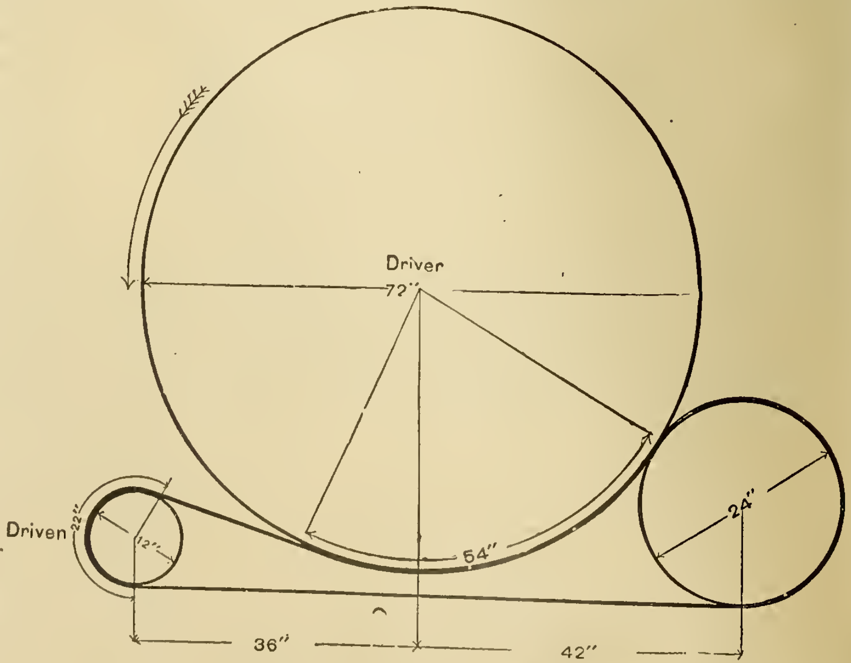


Fig. 2.—Principle of the L. P. & D. System.

of slipping of belt, this will always take place upon the driven pulley. From this it will seem that it is always safe to calculate a larger load than can be driven with the same width of belt and size of pulley, as is the case in direct belting.

This arrangement works equally well where the driving pulleys are below the floor that supports the dynamos and it is practicable to run as many as eight dynamos from an engine equipped with two driving pulleys of 24″ face.—*Stationary Engineer.*

SPARKS.

The Stanton Electric Company has been incorporated with a capital stock of $50,000.

The Peoples Electric Light Co. of Windsor, Ont., is making arrangements to erect a new power house.

The Toronto Industrial School has lately installed an electric plant and will in future do its own lighting.

The annual report of the Dominion Telegraph Co. presented at the 23rd annual meeting, is regarded as being a satisfactory one.

It is reported that the Niagara Falls Power Co. has recently acquired a controlling interest in the Canadian Niagara Power Co.

The Evangelical Alliance has instructed counsel to bring action to compel the Halifax Street Railway Co. to discontinue running horse cars on Sunday.

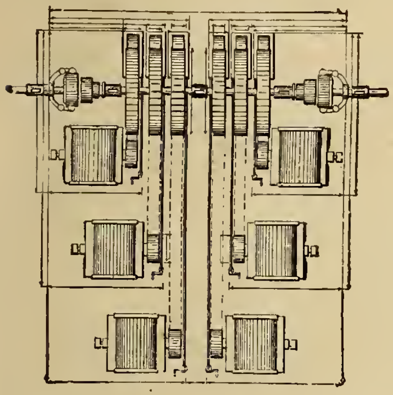


Fig. 3.—Plan for Setting Six Dynamos.

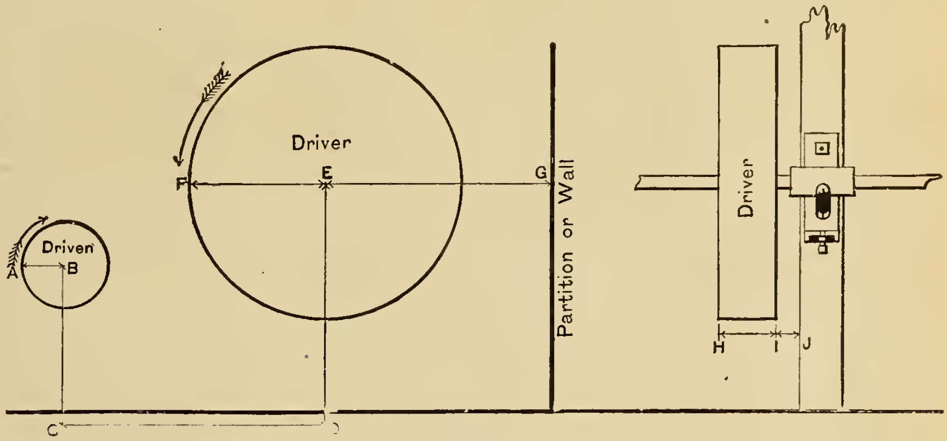


Fig. 4

The Mayor of Montreal has refused to confirm the action of the city council in renewing the electric lighting contract without calling for tenders.

The Hamilton Street Railway Co. propose to test the efficiency of electric heaters, and should they be found satisfactory, all their cars will be equipped with them.

It is said to be the intention of the owners of the St. Catharines and Thorold Electric railway to reconstruct the line next spring, and possibly to extend it to Port Dalhousie.

Mr. Wm. Gibson, M. P., of Beamsville, Ont., and the Messrs. Hendrie, of Hamilton and Detroit, are negotiating for the purchase of the Sandwich, Windsor and Amherstburgh Railway.

The construction of underground metallic circuits and the removal of overhead wires has been largely accomplished by the Bell Telephone Co. in the northern part of the City of Toronto.

A Mrs. Collins, of Hamilton, has been awarded by the courts $5,000 damages against the Hamilton Street Railway Company on account of her husband having been killed by a trolley car.

A committee of Brantford manufacturers has been appointed to ascertain the cost of an electric plant and of power, with a view to establishing a central power station to furnish power to manufacturers.

The Bell Telephone Co. has recently placed small iron boxes in the drug stores throughout the City of Toronto, and a notice thereon requesting persons not connected with the establishment who may desire to use the telephone to place 5 cents in the box. So far as can be learned, the request is not being complied with.

The syndicate which owns the Montreal, Toronto and Winnipeg Street Railways, has also obtained control of the London Street Railway. It is stated that the stock was purchased at about 100 per cent. premium.

A franchise covering a period of 30 years and including exemption from taxation has been granted to Mr. A. J. Corriveau, by the municipality of Notre Dame de Grace, for the construction of an electric railway and for street lighting.

Mr. James Stark, of Ottawa, manager of the Ottawa District and Perth Mica Mines, owned by an English syndicate, states that it is the intention to start a factory in Ottawa or Perth, and ship the material to England and the United States.

The C. P. R. have agreed to build a telegraph line along the Oxford Mountain Railway, from Eastman to Richmond, Quebec, provided the railway company will supply the poles and place them in position to be erected along the line.

The promoters of the Port Arthur Electric Railway, as well as the officials of both municipalities, are endeavoring to secure from the Ontario Government, a statement of the terms upon which the road-bed shall be constructed, and also a decision in other matters in dispute.

The Quebec legislature, at its next session, will be asked to change the corporate name of the Quebec and Levis Electric Light Co., and to grant power to the company to purchase or lease lands or water powers, to lease or sell dams, flumes, canals, electrical appliances, etc.

The City Council of Vancouver has been asked to guarantee for 25 years 5 per cent. bonds of the Electric Street Railway & Light Co., to the amount of $600,000. Should the Council consent to do so, the company will derive a substantial advantage, inasmuch as the bonds are at present bearing interest at the rate of 7 per cent.

A writ of foreclosure has been issued in the Supeme Court against the Halifax Street Railway Co., at the instance of certain bondholders, for the sum of $225,000. The company claim that the bonds held by the parties bringing the action are illegal, and have been repudiated.

The borrowing powers of the Hamilton Street Railway Co., are at present limited to an amount not exceeding the total paid up stock. The legislature will be asked at its coming session to amend the Company's act of incorporation so as to increase its borrowing power, thus enabling the directors to improve and extend the system.

An unknown steamer, on the night of the 9th of November, cut in two the Pelee Island telephone cable. The superintendent of the Government telegraphic service at Ottawa, was communicated with, and the promptness with which, notwithstanding rough weather, his staff succeeded in re-establishing communication with the mainland, is a matter of much satisfaction to the inhabitants of the island.

PERSONAL.

Mr. John Langton, formerly Superintendent of the Edison Works at Peterborough, Ont., makes the announcement in our advertising pages that he has opened an office in the Canada Life Building, Toronto, and is prepared to contract for all kinds of electrical work.

JOHN LANGTON & CO.
Canada Life Building, Toronto
ELECTRICAL · ENGINEERS · AND · CONTRACTORS
Complete Plants installed.
Plants requiring special combinations of Electrical Machinery a Specialty.
CORRESPONDENCE SOLICITED.
"DIRECT-DRIVEN" DYNAMOS for large and small plants. SLOW SPEED GENERATORS AND MOTORS.
Sole Canadian Agents for the Waddell-Entz Alkaline Storage Batteries.

NOTES ON A PROBLEM IN WATER POWER.*

THE present paper is a non-scientific one, and in other respects is not to be classified among the contributions such as are commonly presented before this society. Neither are its objects the same. The purpose is to present some thoughts upon a very important subject, with a view to calling out further and more able discussion. There being nothing exact or determinate to deal with, there will be neither figures nor quantities included, so that no severe mental strain need be apprehended in following the remarks.

The subject is water motors, or, as we commonly say, water wheels, for utilizing the action of gravity of water, and inquiry into the probable condition, inferences or deductions which have led up to and established modern practice as it now exists in this country.

Water wheels, as we have to deal with them, may be classed as gravity wheels, including (1) overshot breast wheels, and perhaps the Poncelet type; (2) pressure wheels, including what we call inclosed turbines and reaction wheels; (3) impulse wheels, driven by spouting water.

The classification thus assumed is, for short, gravity, pressure and impulse wheels. These may be said to cover the various types in common use.

In modern practice the class called pressure turbine wheels constitute perhaps four-fifths of the whole. These can be divided into three general types, namely: The Fourneyron, or outward radial discharge; the Jonval, or downward discharge parallel to the axis of rotation; and the American or inward flow wheels. These have come into general use all over the world, and have a literature of surprising completeness. They are by common consent regarded as the most efficient, and, indeed, until recently, have been the only wheels which were considered in connection with an efficiency beyond 60 per cent.

The question to be presented, and the main point in this communication is, what has produced this particular form in water-wheel practice, and why has pressure instead of impulse been the principle or mode of operation followed in all countries.

Before attempting any answer to this inquiry, it will be well to further examine or explain, in as simple a manner as possible, the nature of the class called turbine wheels.

A column of water resting upon the vanes of a turbine wheel, which are free upon their reverse side, and meet no resistance there, represents complete efficiency less machine friction; and the science of turbines, to so call it, is directed to removing the impeding water and its resistance on the reverse side of the vanes—that is, on the discharge side, after the function of pressure has ceased or has been utilized. It is common to divide the effect of the water, or its functions, in this class of wheels, into gravity, impulse and reaction, but there is no need of such assumption or of introducing the complex nature of these forces thus combined, because the whole is explained as simple pressure, and all observed phenomena point to this as the "mode of action" in pressure turbines.

I am in this assumption, no doubt, transgressing upon what are called established data, but the issue is not important to the subject, and it will be sufficient to call the active force one of pressure alone, and the resistance or loss a result of the imperfect riddance of the water on the reverse or discharge side of the vanes, after it has performed its work by pressure, impulse or otherwise.

Following this method of operating to its constructive features, it involves closed vessels, or conduits, not only to the water wheels, as in other cases, but around them. The wheels must be enveloped in the fluid that drives them, and contained in cases strong enough to sustain not only the static head, but also the effect of water concussion, and in most cases afford support for the wheels themselves and their shafts.

The bearings of the wheels have to sustain the weight of the running parts, also, in many cases, a pressure of the head equal to area of issues multiplied into the head. The wheels are submerged, placed at the bottom of the head or near it, inaccessible to observation, and also for repairs, calling for unusual and expensive provision in the way of bearings and other constructive features, including extra strength of all parts. The hydrodynamic conditions both of entrance and discharge call for complicated forms which cannot with safety be built up, and pressure turbine wheels in this way become large and expensive castings, the value of which depends upon the integrity of every part. If a vane be broken or imperfect, the whole wheel is lost. The diameter being limited because of first cost, a limit of rotative is reached at a head of 50 feet or so, and even at that head the bearings have to run under undesirable conditions; in other words this type of wheels does not permit control of rotative speed, that being limited by both first cost and operating conditions.

Turning now to the other type of wheels, but little known in this country, except on the Pacific coast, the impulse class, and assuming that the force of spouting water is equal to its gravity less an inconsiderable friction in orifices, the question arises, why has not the evolution of water wheels followed on this line instead of pressure for all except low heads?

This is a very important question, one that may well engage the attention of this society, and one that calls for explanation such as will be by no means easy or apparent. It is true that with the class of impulse wheels called "undershot," and some other cruder forms operating by the impulse of spouting water, the efficiency attained has been so low as to lead to the conclusion that the losses were inherent in the method or mode of operation, and this opinion has, it seems, become general without any one very closely inquiring into the matter.

That the efficiency of tangential wheels driven by impulse is as high as can be attained by pressure turbines, has been proven by numerous experiments here, also by some recent experiments at Holyoke, Mass., and is beyond controversy. It has long been settled on this coast, and as a problem no longer exists. No one here would expect under a head of 50 feet or more to attain with any known type of pressure water wheels a higher efficiency than is given out by tangential impulse wheels; but this state of opinion and practice is confined to narrow limits now, and is the more to be wondered at when we consider the rapidity and completeness of investigation in other branches of dynamic engineering at the present day, especially when the economic and constructive conditions in favor of the impulse type of water wheels are taken into account. These we will now consider in a brief way.

There is a wide difference between a water wheel driven by impulse and one operating on the pressure system. The first cost of the former, for a given power, is one half as much, and its maintenance is still less, in proportion.

Figuratively speaking, when a wheel is turned from a pressure to the impulse system, it is taken out of its case, mounted in the open air, in plain sight. All the various inlet fittings are dispensed with and are replaced by a plain nozzle and stop-valve. Its diameter is made to produce the required rotative speed, whatever that may be. The shaft and its bearings are divested of all strains except those of gravity and the stress of propulsion when the water is applied at one side only. Most important of all, there are no running metallic joints to maintain against the escape of water, no friction and no leaks; there are, indeed no running joints or bearings whatever, except the journals of the wheel shaft.

The effect of grit and sand is eliminated, both as to vanes and bearings and there are no working conditions that involve risk or call for skill. If a vane is broken, another one is applied in a few minutes' time. If a large or small wheel is wanted, the change is inexpensive and does not disturb the foundations or connections. Capacity is at complete control; the wheel can be of 10,000 or 1,000 horse power, without involving expensive special patterns. The speed of rotation is not confined to commercial dimensions because of patterns and other causes. It is merely a matter of choice with the purchaser or maker.

Now, granting the efficiency of impluse wheels, which, as before remarked, can hardly be called in question for all heads exceeding 50 or even 30 feet, and conceding the constructive and operating advantages just pointed out, the question at first named rises, why has the evolution of water wheels during 50 years past been confined to the pressure class? Also, why has it been proposed at Niagara Falls to employ pressure turbine wheels under a head of 100 feet or more, when the conditions point to the better adaptation of open or impluse wheels?

It is not necessary in such an inquiry to discuss the problem of horizontal and vertical axis, or other local conditions, in the case of the Niagara plant, or in any other, further than to say that the pressure class of wheels offers no advantages not balanced by equal or greater disadvantages, as will no doubt appear if there should be discussion of this subject before the society. Besides the object of this communication first named, there is the further one of calling the attention of the members present to the impluse or open water wheels so extensively employed on this coast, and to suggest that if possible, they manage to see such wheels in operation under various heads, especially under high heads. In observing a machine of any kind in motion, there are impressions gained which cannot be conveyed by description, but I warn every one against inference from this remark that the tangential water motor wheels on this coast are not scientifically understood and treated. The problems involved may not be so many or so intricate as in the case of pressure turbine wheels, and this is fortunate, because the literature of the latter is one of much complexity to any but skilled mathematicians, and for that reason has not been so much used as it ought to have been.

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* Paper read before the American Society of Mechanical Engineers at the meeting of May, 1892, by John Richards, of San Francisco.

In this country, and it is a most commendable thing to mention, the pressure turbine by an inward flow, or an inward draft, has been greatly simplied in construction, cheapened in first cost, and at the same time better adapted to impure water without losing anything in efficiency. I believe the inward flow turbines made by the Risdon Company at Mount Holly, N. J., have in public tests on more than one occasion shown an efficiency as high, or even higher, than the more finely fitted Fourneyron and Jonval types.

The record of American engineers in this branch is one of which they may well be proud ; and now that impulse wheels of the Girard type have made much progress abroad, and have here in California been modified much as the Fourneyron and Jonval wheels have been in the Eastern states, it is quite time more attention was bestowed upon the subject in other parts of the country. Analogy in the two cases is marked. By an inward flow, American makers reduced the running parts, or the wheel proper, of pressure turbines to a small diameter, increasing its speed accordingly. This lessened the weight and cost of the wheels in the proportion of their diameters, and at the same time dispensed with the accurate fitting involved in the outward and downward flow turbines; and this, as before said, has been done without sacrificing efficiency.

The tangential type of open wheels has been similarly dealt with here in California. The running-water joints have been wholly dispensed with. The construction has been cheapened one-half. The round jet has been applied in the most simple manner, with an increased dynamic effect, and the efficiency attained is believed to be more than is reached by the finest examples of Girard wheels in Europe.

Conceding these statements and facts brings us back again to the query forming the subject of this communication—namely, Why has the evolution of water wheels followed on the line of *pressure* instead of *impulse* ?

SPARKS.

The Central Electric Light Co., of Montreal, has been gazetted by letters patent.

The Lunenburg, N. S., Electric Light Co. has recently placed in position a new 70 horse power boiler.

There is no difference in the heating effect between a continuous and an alternating current.—*Electric Age.*

The Chaudiere Electric Light and Power Company, of Ottawa, is seeking power to increase its capital to $1,000,000.

Mr. D. C. Waters, of Ottawa, is said to have recently purchased for $2,000 a valuable mica mine near Templeton.

The Ottawa City Passenger Railway Company declines to join with the city in an application to Parliament to convert the road into an electric one.

Messrs. John A. Willis and A. M. Wickens have been re-elected representatives of the stationary engineers on the Toronto Technical School Board.

A patent for a self-lubricating trolley wheel, was recently granted to Messrs. John Chas. Mullin, John Bell McRae, and Sydney Leroy Keighley, of Ottawa. Ont.

A contract has recently been signed by the Corporation of Iberville and the St. Johns Electric Light Co., whereby the latter engage themselves to light the town by electricity.

The Ottawa Electric Railway Company have placed in the power house at the Chaudiere another 400 horse power electric generator, making two of that size, the largest of the kind in Canada.

An electric club has been organized in connection with the Peterboro' works of the Canadian General Electric Co.

The Halifax Street Car Company, The Nova Scotia Power Company, and Halifax Illuminating and Motor Company have been sold to an American syndicate, who will operate the street railway by electricity.

In view of the introduction of the electric street car system, the Bell Telephone Co. propose to lay a conduit for the company's wires, from the head office, on Dundas street in London, to the corner of Dundas and Richmond streets.

The Roads Committee of the Montreal City Council has recommended that permission be granted the St. Jean Baptiste Electric Co., the Citizens' Electric Co., the St. Henri Electric Co. and the Merchants' Telephone Co. to erect poles on the streets.

Exclusive telegraphic privileges have been secured by the G. N. W. Telegraph Co., from the new road just opened on the Adirondack and St. Lawrence Railway Co. The G. N. W. Telegraph Co. is at present engaged in constructing a line from St. Johns to Farnham, Quebec.

By resolution of the Board of Directors, the capital stock of the Sherbrooke Telephone Association has been increased to $100,000. The following officers were recently elected: Mr. J. A. Achambault, President ; J. C. Meagher, Vice-president; D. McManany, Secretary-treasurer ; C. Skinner, manager.

A by-law will be introduced in the Winnipeg City Council consenting to the terms of the Bell Telephone Co.'s proposition to establish a metallic circuit, on condition that the city will not grant permission to any other company to construct and operate a telephone system in the city during the next five years.

Mr. Justice Bain has refused to grant the injunction asked for by the Winnipeg Street Railway Co., for the purpose of restraining the Winnipeg Electric Street Railway Co. from operating their lines until such time as the plaintiffs' charter had expired. The case will probably be carried to the highest court of appeal.

The Water Works Committee of the Ottawa City Council propose to impose a tax of $2.00 per car per annum on the Ottawa Electric Railway Co. This action appears to be taken with a view to even things up between the railway company and the hackmen, the latter having to pay $2.00 per annum for water for each horse.

The officers of the Peterboro' Carbon and Porcelain Co., which is successor to the Brooks Manufacturing Co., are as follows : Mr. Cluxton, president ; Mr. Kendry, vice president ; Mr. J. W. Taylor, managing director.

The Smiths Falls Electric Power Co. (limited) has been incorporated by letters-patent of the province, with a capital stock of $60,000. The chief promoters are Messrs. Francis Theodore Frost, Wm. Henry Frost, Charles Berih Frost, Jas. Maitland Clark, Adam Foster and Frederick Arthur Bethune, of Smiths Falls. The company proposes to supply electricity for power and light.

A clutch pulley in the power house of the Rat Portage Electric Light Co. burst recently, seriously injuring John Hegley, J. G. Rushton and L. Stewart. H. Ridout was also slightly injured. Several fragments of the pulley went through the ceiling, and as there were a number of persons in the building, it is considered fortunate that the results were not even more serious.

A large new driving pulley while in process of testing in the Standard Electric Company's power house at Ottawa, on Dec. 20th, suddenly went to pieces. The fragments were hurled in all directions, two of them going through the ceiling. An armature of a new one hundred light dynamo was destroyed, and several things about the establishment damaged, but the dozen employees miraculously escaped injury.

The power house of the Windsor and Sandwich Electric Railway and its contents was destroyed by fire on the night of the 26th of December. The building was of solid brick. This and the fact that the power house stood alone in an open field and that the engine house did not form part of the station proper but was located in a brick addition thereto, makes it difficult to imagine how the fire could have started.

An ingenious method was recently employed in wiring a building for electricity at Rockland, Mass. It was desired to run wires between the flooring and for that purpose a hole was cut at both ends of the room ; then a half-grown kitten, with a slender string attached, was put in at one of the holes, and readily crawled through to the other. A stronger string was then drawn through, then the wire, and the job was done.

She kept the biggest boarding house,
  Of any in the city ;
If any person couldn't board
  With her, it was a pity ;
But she gave up one winter day—
  Did Miss Melinda Molly—
And quit the business when she found
  She couldn't board a trolley.

Owners of isolated plants cannot be too careful in their selection of an engineer. In most cases the engineer must be electrician and dynamo tender. The necessity of having a competent man is obvious. If it is necessary to put ice on the bearings of your dynamos, the engineer should know enough to keep water out of the armature and to see that the floor is kept wiped up. He should not imagine that the commutator is put on an armature for the purpose of being "turned down" in grooves by the brushes. —*N. Y. Electrical Review.*

NOTES.

Mr. George Munro, of Peterboro', Ont., was recently granted a patent on a turbine water wheel.

A cylindrical foot of water weighs 49.1 pounds, while a cubic foot weighs 62.5 pounds, still in the same ratio. We append a few useful multipliers.

Cubic feet of water × 62.5 = pounds.
Cubic inch of water × .03617 = pounds.
Cylindrical inch × .02842 = pounds.
Cylindrical feet × 49.1 = pounds.
183.346 circular inches = 1 sq. foot.
2200 cylindrical inches = 1 cubic foot.

These will give a very accurate approximation and will help in many calculations.

It will pay to set them down in the note book and to memorize those likely to be useful in every day practice.

Journals that have been heated, then cooled with cold water, often break afterward without apparent cause. It has been shown that many such fractures are due to the water treatment, which changes the structure of the metal.

Mrs. Wm. Collette has taken an action for $5,000 damages against the Montreal Elevating Co., on account of the death of her husband, who was an engineer in their service, and was killed by the explosion of a boiler, which, she alleges, had not been inspected.

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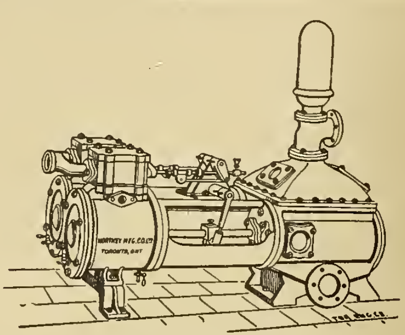
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SPARKS.

An order in council of the Ontario Government has been passed, changing the name of the Brooks Mfg. Co. of Peterboro', Ont., to the "Peterboro' Carbon & Porcelain Co., Ltd."

The Chaudiere Electric Light Co., of Ottawa, have recently put in a new 2,500 light machine, and are putting in another 5,000 incandescent light machine. The latter is said to be the largest electric light machine in Canada.

At a meeting of shareholders of the Victoria Electric Co., Ltd., Victoria, B. C., it was decided to increase the capital stock of the company to $75,000, paid up, and the directors were empowered to incur an expenditure not exceeding $40,000 for increasing the plant and improving the premises. A contract has since been entered into with the Canada General Electric Company. The plant purchased includes two Edison dynamos 3,340 light capacity, 16 candle power each; two 150 h. p. slow speed engines, capable of giving nearly 400 h. p., and three 150 h. p. boilers, tubular. By providing three new boilers there will be one to spare. The new plant will about double the present capacity and service. The contract includes $6,000 to $7,000 worth of wire to put all mains, feeders and distributors in thorough and efficient working order. It is also contemplated in the near future to add to the arc plant by the introduction of an all night, all year round service, Sundays included; these lights to be of 2,000 candle power. A lease of the brick premises at the corner of Langley and Fort streets has been secured by the company for ten years on very favorable terms. The old building on Langley street is being bricked and improved. The contract is to be completed in 90 days from the 9th of November, 1892. A friendly understanding has been arrived at between the National Electric Light and Tramway company, and the Victoria Electric Company, that fair prices shall be maintained, so as to put the business of supplying electric light on a commercial basis by making the stock pay a commercial dividend. At the same time consumers will be given first class light and the best possible satisfaction at a reasonable price.

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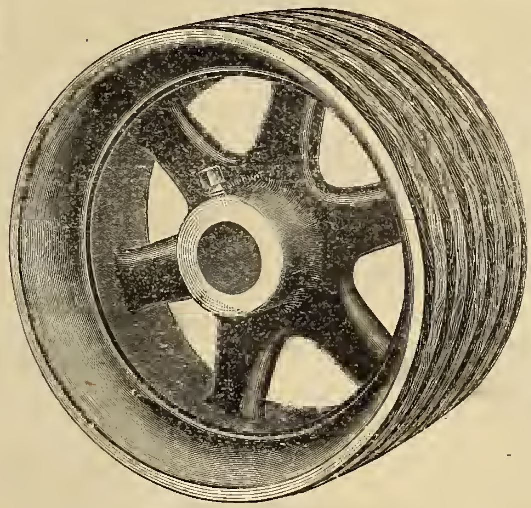

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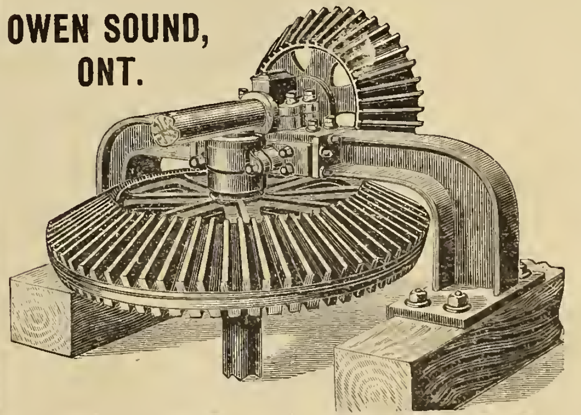

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SPARKS.

The Westville, N. S., Electric Light Co. is substituting incandescent for arc lights.

We are indebted to the *Electrical World* for a large size colored lithographic illustration of the Electricity Building in connection with the World's Fair.

The Woolley Electrical Appliance Company at Barrie, Ont., are applying for incorporation with a capital stock of $25,000, to manufacture the Woolley electric magnetic apparatus and other electrical appliances.

A petition has been sent to the Montreal City Council against the running of electric cars all winter. The plea for this is that the streets on which the cars run will almost be bare of snow and prevent sleighing, while other streets will be covered with snow and forbid wheeling.

A change in the directorate of the St. Johns', Que., Electric Light Company has recently been made, Messrs. Trotter and Turnbull retiring. The vacancies thus created have been filled by Messrs. J. B. Tresidder, of Iberville, and J. B. Hutchison, of Montreal. Considerable improvements are being made in the electric light station.

The County Council of York have granted the right of way on the Kingston road from the Woodbine corner to Highland Creek to the Toronto & Scarboro Electric Railway and Lighting Co., providing the rate of passenger fare shall not exceed 3c. per mile from Toronto to Scarboro Junction, and 2c. per mile for the remainder of the distance.

The difficulty of maintaining schedule time with a large number of cars is well recognized; and on many lines if a car be delayed by an accident for a quarter of an hour or 20 minutes, the whole line would be so deranged that schedule time will not be overtaken during the whole of the day. In Denver where there are 74 miles of eleclric and 13 miles of cable tracks, requiring about 103 trains in daily operation, this is especially important. It was found that a breakdown of any kind on the road inevitably disorganized the traffic, since the making up of time rested chiefly with the conductors. To obviate this a system of telephone circuits has been arranged with various call points, all communicating with the head office. Every conductor on arriving at the terminns of his route immediately reports to headquarters the number of his car, and receives in reply his proper leaving time and any instructions that may be necessary. The dispatch clerk is thus advised of the whereabouts of each car, and is able often to fill up a space of from 30 to 60 minutes caused by a "parade." Of course it is impossible for one car to jump another by the cable or electric systems, and hence the proper control of the cars is of more importance than with horse service. As a set off against the expense of the telephones may be taken the saving of starters at the various termini. The telephones are estimated by the Denver Company to give a saving of at least 80 per cen over the cost of the old system.

New Facts about the Dakotas is the title of the latest illustrated pamphlet issued by the Chicago, Milwaukee & St. Paul R'y regarding those growing states, whose wonderful crops the past season have attracted the attention of the whole country. It is full of facts of special interest for all not satisfied with their present location. Send to A. J. Taylor, Canadian Passenger Agent, No. 4 Palmer House Block, Toronto, Ont., for a copy free of expense.

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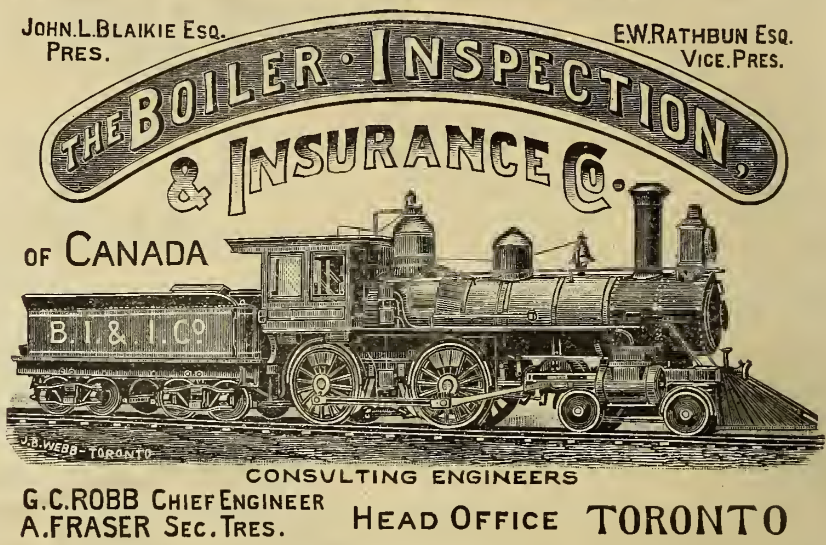

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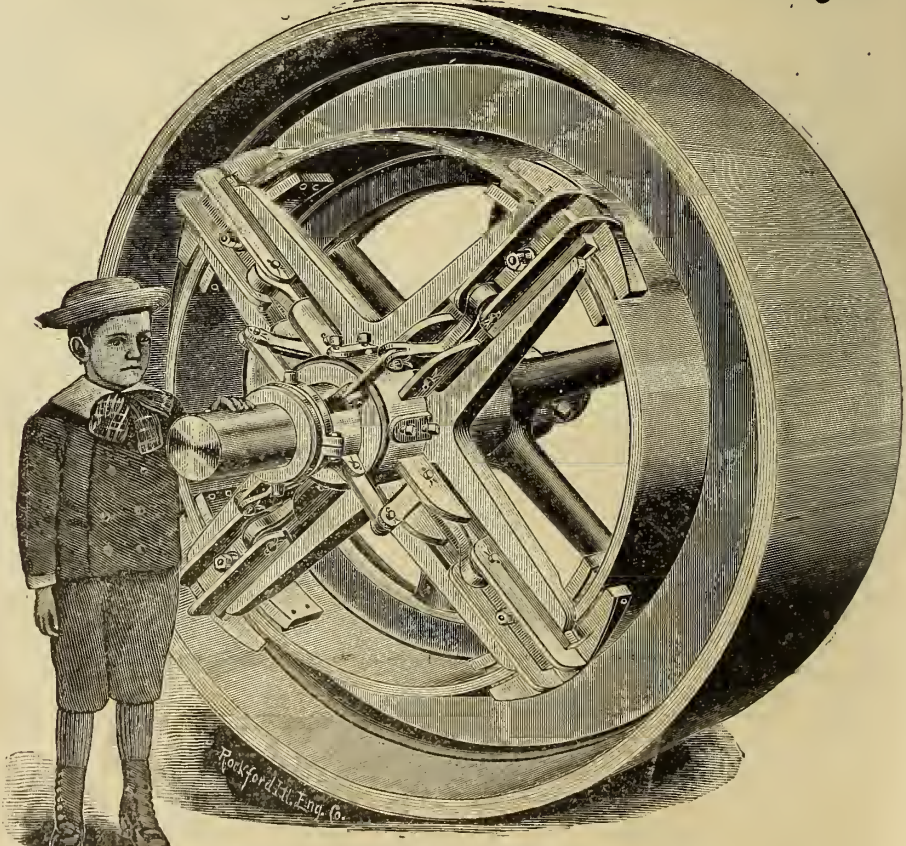

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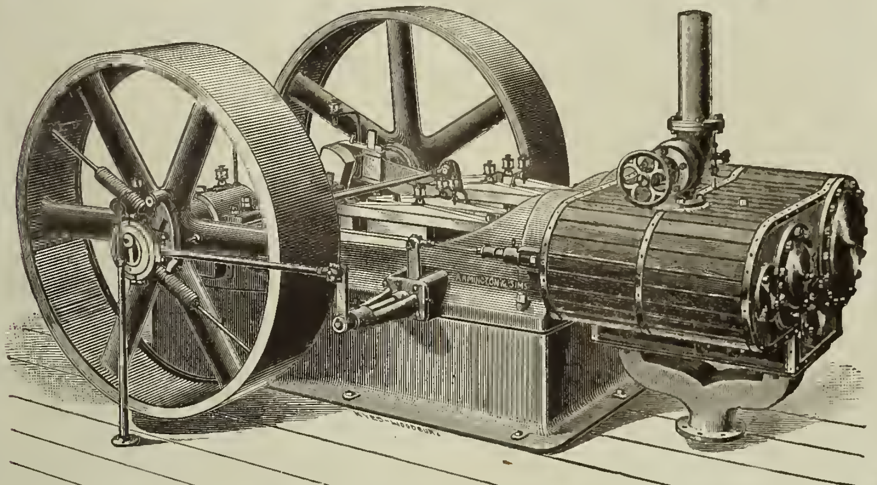

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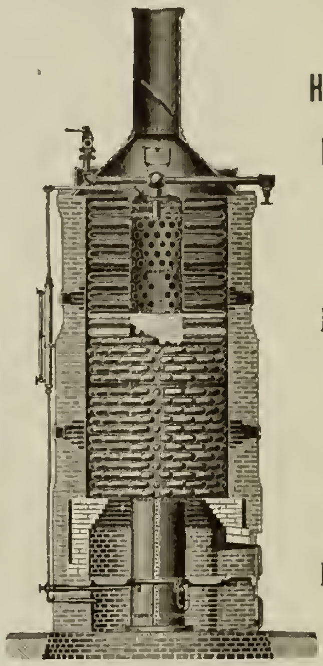

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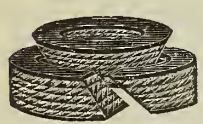

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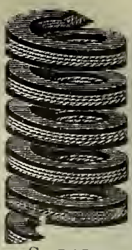

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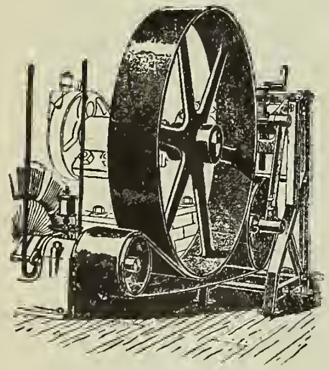

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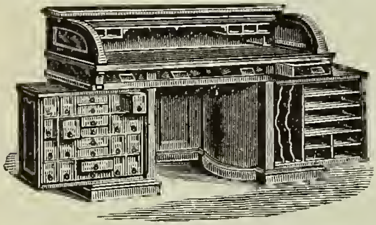

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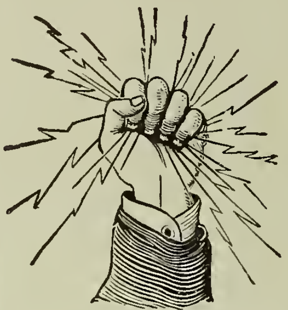

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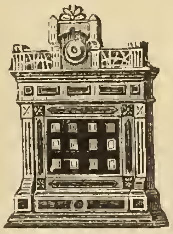

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The Berlin Electric and Gas Co.
The Woodstock Electric Light Co.
The Manitoba Electric and Gas Light Co., Winnipeg.
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We are the only Belt Manufacturers in this Province who can show Belts of OUR OWN MAKE which have been in use AS LONG AS FIVE YEARS. We can point to belts of our own make in THIS CITY ALONE which have been in constant use for TEN, THIRTEEN and even NINETEEN years, and are still good.

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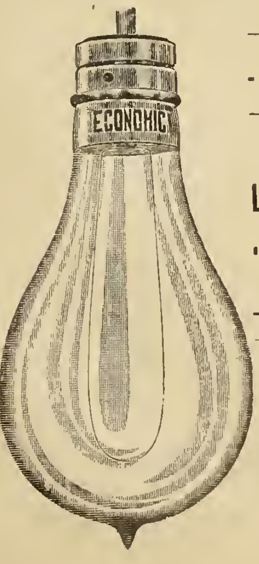

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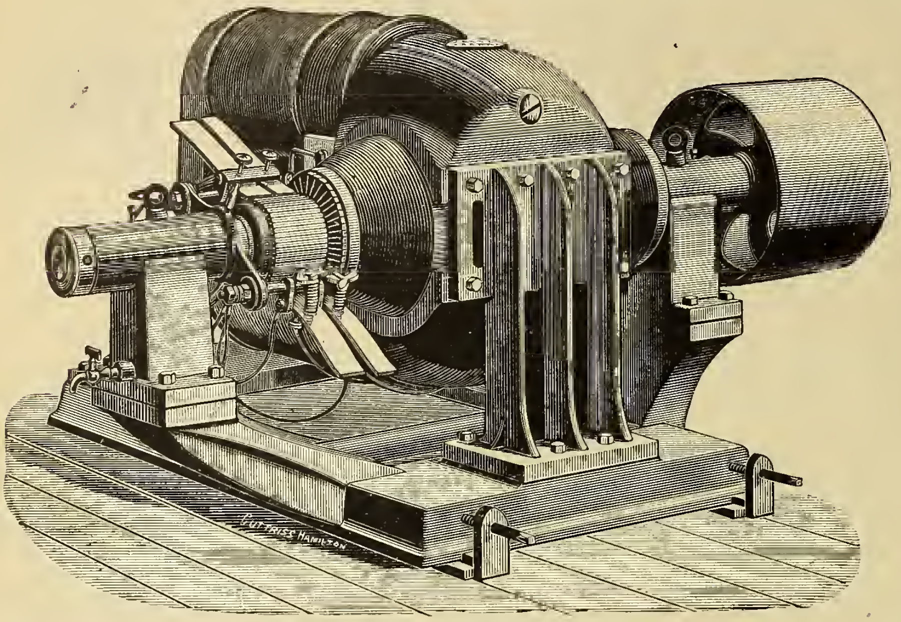

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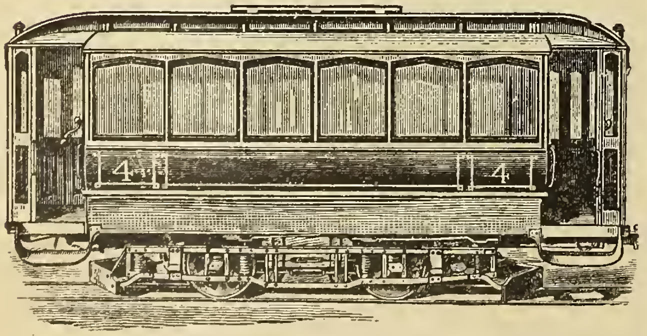

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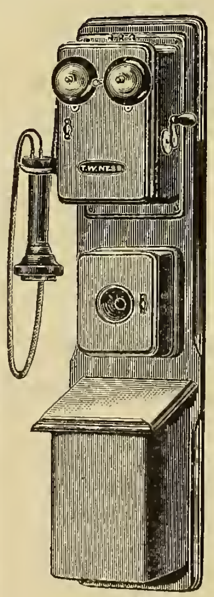

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Local exchanges fitted up. All line material supplied.

STE. JULIE, Sept. 5th, 1892.
T. W. NESS, ESQ., Montreal.

DEAR SIR,—We are happy to state that your telephones and switches are giving us good satisfaction. We have three sorts of switches and we find yours far preferable. There is now about forty of your telephones in operation on our line. Every one works well, and we intend to use no other.

Yours very truly,
THE MEGANTIC TELEPHONE CO.

Write us when you want anything electrical.

Key Sockets,
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CANADIAN

ELECTRICAL NEWS

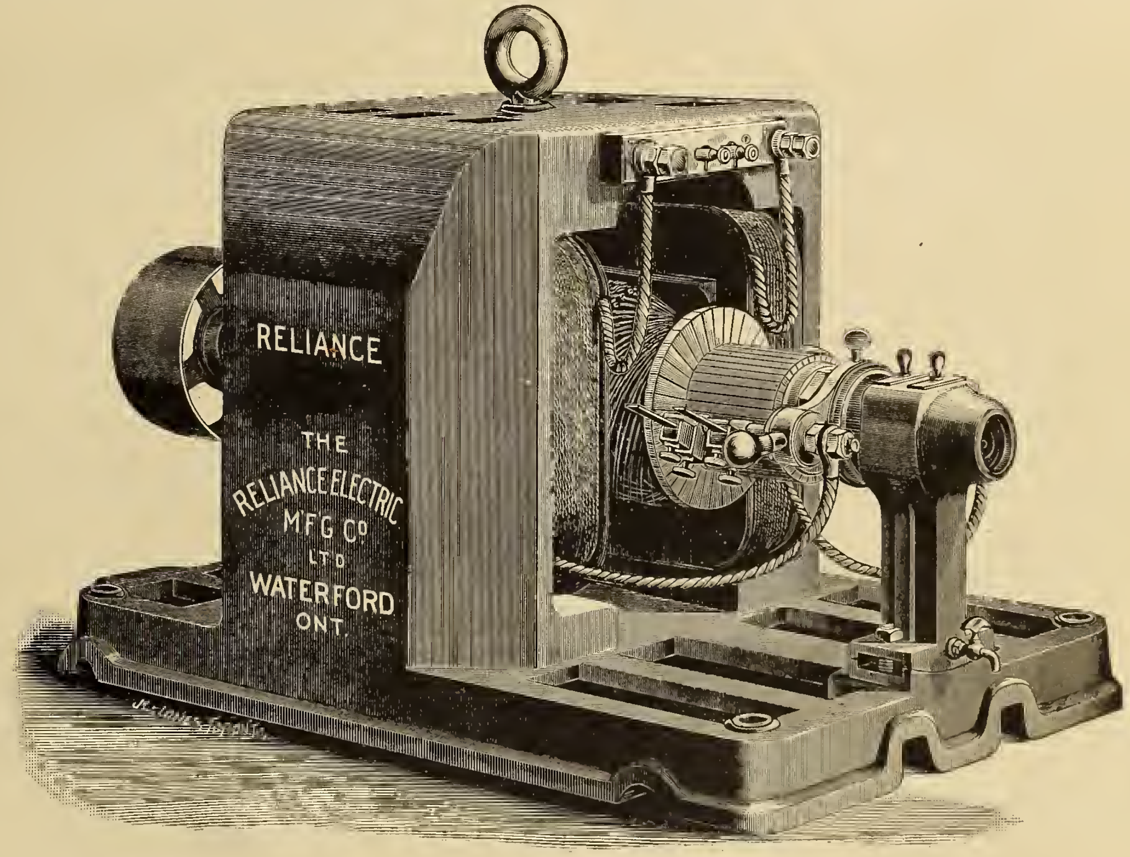
AND

STEAM ENGINEERING JOURNAL.

VOL. III. TORONTO AND MONTREAL, CANADA, FEBRUARY, 1893. NO. 2.

NEW DYNAMO OR MOTOR.

A new dynamo or motor always attracts the attention of those interested in the electrical business, not only on account of the peculiar features and improvements it may embody, but because there is a very wide difference in the results which are accomplished, and a dynamo or motor that would win favor to-day, must do so on its merits. Cost of construction, economy of power and maintenance, durability, safety of the armature from burning and simplicity of action, are all items of importance to the purchaser. To attain the above results, has been the object aimed at by the Reliance Manufacturing Co., of Waterford Ont., in designing the machine which is herewith illustrated. While it has been successfully introduced, it has not been brought prominently to notice. This machine is of the iron clad type; the entire frame and bearing supports are one casting, having no joints to introduce resistance in the magnetic circuit, and so designed that the field magnets are brought as close to the armature as possible, with the object of making a complete utilization of all the lines of force. Mechanically the design is simple in construction and occupies little space; the bearings are self-oiling and aligning. It operates without sparking at commutator, which is ample in length and diameter, and is supplied with copper or carbon brushes as the purchaser may desire. The manufacturers claim that it gives perfect regulation from full to no load.



These machines are manufactured for generators and motors for 125, 250 and 500 volts current standard windings. Dynamos or motors are upon special order, made for any current voltage.

QUESTIONS AND ANSWERS.

A correspondent writes: An electric light plant (Ball arc, 4 amp.) is driven by a Corliss engine 14″×36″, 75 revolutions per min.; there are some incandescent lights run in series on arc circuit, and at times they fluctuate quite peerceptibly at the rate of 72 to 75 per minute. What is the cause? Kindly answer in February NEWS.

ANSWER.—The governor connection to engine's cut-off probably causes the cut-off to take place earlier at one end of the stroke than at the other. An engine in this conditlon and making 75 revolutions per minute, will make 75 attempts to go a little faster each minute. Have an indicator put on your engine and get valve arrangements adjusted to make diagrams from each end as nearly alike as possible.

TRADE NOTES.

Messrs. Robin & Sadler, leather belting manufacturers, of Montreal, are sending out a neat little celluloid memorandum tablet, on the reverse side of which is given a price list, per running foot, of double and single belts.

The Reliance Mfg. Co., of Waterford, Ont., report business very brisk and the outlook bright for the new year. They have recently made the following sales: 165 H.P. generator 500 volts, 25 H.P. motor, 10 H.P motor to W. Cooke & Son, St. Catharines, Ont.; 50 H.P. motor to R. H. Smith & Co., St. Catharines; 10 H.P. motor to A. Meyers, St. Catharines; 7 H.P. motor to The Empire Carpet Works, St. Catharines; 15 H.P. motor, 10 H.P. motor to Hilliard & McKinley, London, Ont.; 10 H.P. motor to J. O. Parker, Toronto; 250 light incandescent plant to Grand Central Hotel, St. Thomas; 60 light incandescent plant to James Robertson, St. Thomas; 50 light arc plant to Brantford Electric and Power Co., Brantford; 220 light incandescent plant to John B. Kelly, Blyth, Ont.; 30 light arc plant to The Verity Plow Works, Brantford; 15 light arc plant to Waterloo Mfg. Co., Waterloo, Ont.; besides a number of small motors.

CANADIAN ELECTRICAL ASSOCIATION.

THE second Convention of the above Association took place in the School of Science, Toronto, on Wednesday and Thursday, Jan. 25th and 26th. The Executive had fitted up temporary headquarters at No. 40 York street, which were placed at the disposal of members during their stay in town.

The Executive Committee held a meeting at 11 a.m. on the 25th, and elected a dozen new members.

The first session of the Convention opened at 2 p.m. in the School of Science, with the president Mr. J. J. Wright, in the chair. The Association was warmly welcomed by Mr. T. R. Rosebrugh on behalf of the Faculty of the School.

The following members were present:

John Carroll, Eugene Phillips Electrical Works, Montreal, 2nd Vice President; C. H. Mortimer, publisher ELECTRICAL NEWS, Toronto, Secretary-Treasurer; D. A. Starr, Royal Electric Company, Montreal; H. O. Fisk, Electric Light Company, Peterboro'; A. B. Smith, Canadian Board Fire Underwriters, Toronto; D. Thomson, general manager Hamilton Electric Light and Power Company; W. A. Johnson, Ball Electric Co., Toronto: John Yule, manager Guelph Gas and Electric Light Company, Guelph; Thomas H. Wadland, Bell Telephone Company, Hamilton; L. B. McFarlane, Bell Telephone Company, Montreal; H. P. Dwight, President G. N. W. Telegraph Co., Toronto; A. M. Wickens, electrician Ontario Parliament Buildings, Toronto; George Black, G. N. W. Telegraph Company, Hamilton; J. A. Baylis and W. A. Tower, Bell Telephone Company, Toronto; R. G. Black, Hamilton; A. T. Smith, Bell Telephone Company, Kingston; B. J. Throop, Bell Telephone Company, Hamilton; George M. Wight, Royal Electric Co., Montreal; J. H. Greer, Bell Telephone Co., Peterboro'; H. Beaumont, Toronto; J. W. Taylor, Carbon and Porcelain Works, Peterboro'; J. A. Kammerer, Royal Electric Company, Toronto; Geo. W. Sadler, Robin & Sadler, Montreal; F. C. Armstrong, General Electric Co., Toronto; W. Bourne, Toronto Electric Light Co.,; H. S. Thornberry, Toronto Electrical Works; W. J. Jones, Bell Telephone Co., Toronto; Hugh Neilson, Bell Telephone Co., Toronto; W. B. Evans, A. Knowles, Bell Telephone Co., Toronto; W. R. McLaughlin, *Electrical World*, New York; W. J. Clarke, Bell Telephone Co., Toronto; Capt. R. F. Carter, Electric Light Company, Niagara Falls, Ont; Chas. B. Hunt, Electric Light Co., London; Alex. Stark, Bell Telephone Co., Toronto; John Langton, Toronto; E. C. Breithaupt, Berlin; James P. McQuaide, National Conduit Co., New York; A. B. McCallum, Peterboro'; J. M. Campbell, Electric Light and Power Co., Kingston; Isaac Usher, Thorold Ont.; E. E. Slaght, President Reliance Electric Mfg. Co., Waterford, Ont.; R. E. Gardiner, Electric Light and Power Co., Hamilton; Prof. Galbraith, Mr. Rosebrugh and E. B. Merrill, School of Practical Science, Toronto; A. M. Wright, Electric Light Co., Renfrew, Ont.; W. A. Martin, Toronto Electric Light Co; C. E. McManus, G. N. W. Telegraph Co., Toronto; Fred. C. Robertson, C. P. R. Telegraph Co., Toronto; Joseph Wright, Bennett & Wright, Toronto; J. A. Doucett, Bell Telephone Co., Toronto.

PRESIDENT'S ADDRESS.

Gentlemen of the Electrical Association: It is with great pleasure that I meet you again after another half year's experience of our rapidly moving industry. Since last I addressed you several changes of importance have taken place in its aspect, and new departures have been made that will have considerable influence on the future of electrical business in Canada. The adoption of electricity as a motive power on suburban railroads and the conversion of horse tramways has developed in a manner that for rapidity is without a parallel in the history of modern civilization. While a year or two ago it was thought that the limit of production had about been reached and the demand for electrical apparatus filled by the occupation of the field of arc and incandescent lighting, it is a fact that to-day our workshops are as far behind in keeping the market supplied as at any time in the history of the business. This, occurring as it does during a period of general depression, must be looked upon as eminently satisfactory, and as affording a guarantee of much greater expansion in the future. I have to congratulate the members of this Association that their field of usefulness is becoming wider, and that the outlook ahead is so bright and full of promise. While this is the case, and it is undoubtedly a fact that solid and substantial progress has been made by conservative management of electrical enterprise, a word of caution may not be out of place to investors in securities based upon electrical speculation. There is a danger that the fact of this solid progress may be made the means of ultimate injury to the concerns identified with it. It has caused a growth of schemes, having electricity as a basis, to spring up as thick and fast as mushrooms. The inevitable failure of many of these will discredit, to a certain extent, legitimate enterprise and profitable business.

The many schemes for the long-distance transmission of power, though scarcely to be classed with what may be termed the electric fake, are still somewhat far removed from the line of commercial success. Experimentally much has been accomplished in this direction, though the complicated nature of the apparatus and its cost for operation and repair, make financial success rather more than problematical. At the last convention of this Association I took occasion in opposition to views then set forth, to mildly satirize the hundred miles an hour enterprise that was to carry the denizens from the wilds of Missouri to the World's Fair at Chicago. Where is that enterprise to-day? Several miles of road are constructed—all but the track—in a straight line, too, I believe, as considered necessary by the projectors, but no plans are forthcoming, and we do not see the name of any engineer of standing connected with the scheme. The sole energy of the promoters appears to be expended in the production of a very rosy-colored prospectus showing impossible profits, and an elaborate engraving of the happy farmer sawing wood and pumping water by electric light and power for a couple of miles on either side the right of way.

To come nearer home, good hard dollars have been extracted from the pockets of liege subjects of the Queen in the name of electricity, as the magic wand was waved even under the nose of Brock's effigy on Queenston Heights. Where is that scheme now? The Utopian dream of a railroad on every farm that is being promulgated now will not materialize in our generation, except as a sink-hole for the funds of the unwary. A word of warning is needed now, and as President of this Association I give it. It is open to you to dissent from this position, to criticize it if you see fit, and to prove it needless if you can. The safety of legitimate electrical enterprise is endangered by this trading upon the credulity of the people. Nevertheless genuine electric business has made solid progress; its area is gradually widening, and a natural and healthy growth will find increasing occupation for its earnest workers, and afford a fair and reliable return to prudent investors. During the half year just passed there does not appear to have been many new developments in the scientific application of electricity. Effort appears to have been expended in perfecting already known appliances and inventions. Much progress has been made in this field. The best efforts of electricians and mechanics have been devoted to street railroad appliances, and while much yet remains to be done a distinct advance has been made in the perfection and durability of railroad plant. Some new departures have been made in the engineering branch. At our last convention I described what I considered to be the ideal engine for electric light work. That engine has been constructed, and I shall presently have pleasure in asking you to examine its operation. It has more than justified the anticipations of its designer, and has proved a remarkable success. The vertical type of large engine has entered the field of electric work, and is there to stay. Electric generators, taken as units, are gradually growing larger; 250 horse power is not an uncommon size, and the largest yet designed and constructed on this side of the Atlantic has attained to the extraordinary capacity of 2,000 horse power.

I would like to foreshadow action by this Association such as would unite in a closer bond the members whose interests are to a considerable extent identical. It will become an important matter for us to decide, if it is seen fit, either at this or at the annual meeting in September next, whether it would not be advisable to organize subsections of the Association, to more successfully grasp and deal with details that would be somewhat beyond the scope of the Association in its entirety—such, for instance, as the question of fuel supply. In the province of Ontario alone, where all our coal has to be imported from outside sources, the amount consumed for the purpose of generating electricity must reach a considerable sum in the aggregate. United action on the part of owners and operators of central stations which would establish direct communication with the miners of coal, might result in considerable advantage in the matter of its ultimate cost. A sub-section of the Association, comprising central station owners and operators, could handle a question of this kind, while on the other hand it would not be of great interest to a large contingent of members interested in other branches of electrical science. Electrical men generally, who are all more or less consumers of electrical supplies, are interested in the question of railroad freight and charges. It has been suggested to me that the Association take up the matter and endeavor to have a classification of electrical apparatus, graded in such a manner as to materially modify the high rates of freight at present obtaining on some kinds of electrical material, and so on through the various branches of the industry represented by the Association at large. Other amendments to the constitution will have to be considered in preparation for a revision at the forthcoming annual meeting. If I have not before referred to the telephonic branch of electrical work so fully represented in our membership, it has not been by any means from want of a sense of its importance and magnitude. The amount of work now being prosecuted by its intelligent and industrious contingent of members is equalled only by that performed by the ubiquitous and rapid street railroad man. In fact, just now it is a struggle for the top of the heap, with the odds in favor of our friends of the telephone. The introduction of their enemy, the trolley car, has brought into play all the skill and resource at their command, and so well has the skill been applied that the immense disability caused by the operation of heavy railroad currents has not only been overcome, but the results obtained are, in the large majority of cases, better than ever. To accomplish this herculean task it has become necessary to do a large amount of subterranean work. This branch of construction is one of growing importance, in fact one which concerns the electric light man as well as the telephonist in the larger towns and cities, and I am glad that we are to have some information on the subject from one of the fraternity well qualified to impart it.

Leaving the consideration of practical matters connected with our industries, and glancing at its possibilities, it would seem that there are several new developments well within their range. The production of light without heat is a problem that is worthy of the best efforts of the inventor. The experiments of Elihu Thomson and Nikola Tesla with currents of high frequency have been full of significance and promise on this point. Whether a sufficiently high rate of frequency will be attained to identify the vibrations of electricity with those of light, or whether a sufficiently mobile material can be discovered as a medium of transmission, remains for the future to disclose, but the fascinating possibility of a cold and luminous wire as a means of illumination appears to be a consummation worthy of the best efforts and the highest intellects of the human race. The possibility of the production of electricity, and consequently power, from light, would seem to follow this in natural sequence, while those existing in the discovery of a commercially successful application of thermo-electricity would appear to provide plenty of material for the facile inventor. While we deplore the pettifogging tactics of the electric charlatan, we have unbounded faith in the future developments of the science. Owing to the perfection of constructive mechanism, the full fruition of invention and discovery is attained with a rapidity unknown in the days of our fathers when the evolution was a slow and painful groping after perfection. This being the case, we may hope in our own proper persons to behold future achievements as wonderful to our enlightened minds as would be ours of the present day if seen by our predecessors of but a few short years ago.

The President: I will now call upon Prot. Rosebrugh to say a word or two to us.

Prof. Rosebrugh: Mr. President and gentlemen, I am sorry that the Principal of the school is not here to welcome you, but, in the name of the school, I am very happy to be able to throw open the doors of the institution to you; and I hope this will not be the last occasion upon which we shall have the pleasure of having meetings of this kind held in the school. With regard to the laboratories of the school, there are too many present to be personally conducted through them with a view to explaining everything, but we shall be very glad if you will make yourselves perfectly at home, and look around and see what is to be seen downstairs.

SECRETARY'S REPORT.

GENTLEMEN.—There is cause for congratulation in the success which marked the first convention of the Association, held in Hamilton in June last. The attendance, as well as the interest attached to the proceedings, were most gratifying, and should encourage the hope that a career of usefulness and prosperity awaits the Association in the future. It is a matter of some regret that a larger addition has not been made to the membership during the last six months. The Association has reached its present standard largely through the exercise of personal effort on its behalf, by those interested in its success. In no better way can its membership and influence be advanced in the future. If this hint be borne in mind, especially by those members who are regularly brought into business contact with persons interested in electricity, there is no reason why the membership should not reach at least one hundred and fifty before the second annual convention in September next.

The Executive Committee has held three meetings since the Hamilton convention, viz.: on the 8th of August and 21st of November, 1892, and immediately prior to the opening of the present convention.

At the first of these meetings, the Treasurer presented a statement of the expenses in connection with the Hamilton convention, amounting in all to about $200, the accounts for which were passed and ordered to be paid. The sum of $25 was voted to the Secretary-Treasurer to reimburse him for incidental expenses. Mr. D. Thomson was appointed Chairman of Committee on Statistics. The Secretary was instructed to have 400 copies of the Constitution and By-laws as revised at the Hamilton convention, printed and distributed to members.

At the meeting on the 21st of November, Messrs. Wright and Dunstan were deputed to complete arrangements with the authorities of the School of Practical Science and to fix the date for the present convention, while the Toronto members were delegated to arrange for the renting of suitable temporary headquarters for the Association, and complete all further arrangements for the convention.

There have also been held at various times, meetings of the official members resident in Toronto, at which arrangements for securing papers to be read at this convention, as well as other matters of detail, were dealt with, thereby avoiding the necessity for more frequent meetings of the Executive.

There have been added to the membership since last convention, 7 active and 4 associate members, bringing the present total membership up to 119.

The statement of receipts and disbursements since date of last report, is as follows:

Receipts.

June 1st, 1892, cash on hand		$ 20 25	
June 1st, 1892, cash in Merchants' Bank		199 99	
36 Active members' fees		180 00	
6 Associate members' fees		12 00	
Balance of Active fee for W. A. Tower		3 00	
Balance of Active fee for J. H. Greer		3 00	
Cheque from Bell Telephone Co		25 00	
Cheque from G. N. W. Telegraph Co		25 00	
			$468 24

Disbursements.

Expenses of Convention at Hamilton		$ 94 00	
Telegram	$ 45		
Hotel bill	3 50		
Railway fare	1 95		
Express	50		
Cab hire	14 00		
Caterer	68 60		
Caretaker Board of Trade	5 00		
Reporting proceedings of Convention		20 00	
Grant to Secretary		25 00	
Postage		13 30	
Printing and stationery		79 36	
Certificates and badges		25 40	
Register, stamp and receipt book		2 65	
Exchange on cheques		35	
Cash in Merchants' Bank, Jan. 24th, 1893		191 43	$451 49
Balance in hand		16 75	16 75
			$468 24
Total balance in hand Jan. 24, 1893			$208 18

In conclusion, I would express the hope that the present meeting will be attended by such a measure of success as will awaken the renewed interest of every member in behalf of the future usefulness of the organization, in order that its progress may keep pace with the rapid development of electrical industries in this country.

Moved by Mr. A. B. Smith, seconded by D. A. Starr, that the report be accepted. Carried.

REPORT OF COMMITTEE ON STATISTICS.

Your Committee on Statistics beg to report progress, and also to request that they be authorized to draw on the funds of the Association for the amount necessary to have printed some two or three hundred blank forms containing a set of questions to be asked of every electric light and power company, also telephone and telegraph companies, within reach of ordinary postal facilities, also the necessary stamps and stationery, so that they may be able to compile a list of statistics that will be valuable for future use.

D. THOMSON, Chairman

Moved by Mr. D. A. Starr, seconded by Mr. A. M. Wickens, that the report of the Committee on Statistics be adopted. Carried.

The President: I would like an expression of opinion from some of the members present on a suggestion that was made a short time ago with regard to sub-dividing the Association in sections. The members appear to be taking things very much for granted, but I think we should have an expression of opinion in regard to this.

Mr. A. A. Wright: I do not exactly understand the suggestion; it is entirely new to me. As far as I am concerned, I suppose you refer to the matter of fuel; is that the point?

The President: No, that is not it; the question is whether it would not be advisable in the interest of the Association, to form sub-sections of the Association, comprising the different branches, so that any matter which specially or solely affects anyone of those branches could be dealt with by that branch, while questions affecting and interesting the electrical fraternity generally would be dealt with by the Association at large.

Mr. Armstrong: Would it not be well for some member of the Committee to explain the thing a little more at large.

The President: An amendment would have to be made to the constitution at the convention in September. This being the only meeting of the Association that will take place before then, it seems to me to be a proper time to discuss the matter, and elaborate any scheme which may seem desirable.

Mr. A. A. Wright: I do not really understand this thing yet. Do you wish to have a sort of sub-sections, that is, to have committees appointed to look after certain sub-divisions of the work, or do you want to have other electrical associations for each part of the Province?

The President: Not at all; I thought I made myself plain. I said sub-sections of this Association. Some of those present may be members of the Toronto Board of Trade, and familiar with the manner in which it is sub-divided into sections, such as the coal section, the drygoods section, the grain section, etc. Now, we have an Electrical Association, having among its members gentlemen representing all of the various electrical interests of the Dominion: the telephone, the telegraph, and electric lighting companies, etc. Now, there are matters sometimes arising which are of interest solely and only to some one of those branches. Such a question, the adoption of a uniform standard for electric lighting, was debated at the last convention. That is a question interesting only to those who are engaged in the production of electric light, and it does seem that they are the men who should decide upon any policy referring solely to their interests. It might be that the telephone branch of the Association would find occasion to take action in some of the various matters appertaining peculiarly to them, and which they did not desire to have passed upon by the Association generally as it referred to them solely. That is the way in which the idea originated, of forming the Associations into sub-sections, to handle matters distinctly belonging to such branches or sections. For instance, there would be a section of central station men. The Association was originally formed for the purpose of bringing together those who were engaged in all branches of electrical business, that they might legislate for their own good, and it is now the question whether you think, in order that the Association may achieve its highest usefulness, that it is advisable to take some such action as I have endeavored to outline.

Mr. A. A. Wright : I have no doubt that is a very good idea, as we are not all interested alike in those objects.

Mr. H. Neilson : I think you will find, if you will consider for a moment, that there will be only one section. On matters of policy affecting the Bell Telephone Company, which is the only telephone company in the country, and the telegraph company, the policy of those companies is dictated from the head office. I do not see how a telephone section would have anything affecting it to discuss, or upon which to frame any rules or regulations. The electric light is entirely different. You have many and divergent interests there ; you have a company in nearly every city and town in the country, and there is, no doubt, great difference of opinion such as cannot possibly exist in the case of the telephone company, and to a certain extent in the telegraph company. So that, if you form an electric light section you can can go on and do your business entirely irrespective of the other two.

The President : Of course, speaking as I did, I did not wish it to be understood that I expected that the members of the telephone section of the Association were going to dictate the policy of the company. But there are many matters interesting to the telephone men, apart from the policy of the company, with which such a section could deal.

Mr. Kammerer : I think it would perhaps be well for the present to pass over this matter, and let it be made a special order for to-morrow.

The President : Is that the pleasure of the meeting? If no member is ready to bring the matter forward, perhaps that is the best course. I am only giving voice to suggestions I heard made among some of the members, in fact, I think Mr. Neilson himself was one of those who suggested the idea originally, or, perhaps, it was Mr. Dunstan. And, by the way, I am very sorry that Mr. Dunstan is not here with us ; I understand he was prevented by some family bereavement from, being here to-day. However, the matter under discussion is entirely in the hands of the Association ; I do not press it at all, in any shape or form. I merely bring it before you in my capacity as President of the Association, that is all. I may say, also, that we shall be glad to receive suggestions from any member of the Association as to any amendments to the constitution that he may think will be calculated to advance the interests of the Association, so that we may talk over them and have them formulated and relegated to the hands of the committee which will be appointed to look after the matter, and bring it before the convention in September. Has any member any new business to bring forward?

Mr. G. Black, of Hamilton, then read the following paper :

ELECTRICAL MEASUREMENTS.

In agreeing to write a paper to be read at this meeting, I may say that I do not pretend to offer anything new to the majority of this assembly, but hope that my efforts may be of service to some of the younger or less experienced members. I selected the subject with a view to interest a larger number than a purely telegraphic paper would likely do.

In the early days of the telegraph, very little was known of the science of electricity ; the laws of the current and of resistance were imperfectly understood, and escape or leakage was our special bugbear. In the good old days we were satisfied to believe that the current flowed, and we put on battery enough to give a working circuit. With the Grove battery then in use we could do it, but the escape was sufficient to knock out the present generation of "operators." We observed that some wires required more battery power than others of a similar length, and wires were called "good" or "bad" accordingly. Formerly we were satisfied to know that a circuit was established. Now the practical electrician should know how much current is required and how much resistance is offered to it, or he knows nothing. The successful laying of the Atlantic cable led to more scientific methods in the telegraph systems of this continent. The adoption of duplex and quadruplex transmission called for lines in first-class condition. The wonderful achievements of the first telephone experimenters led others to believe that insulation or resistance might be disregarded, but more accurate observation indicated that the telephone came under the same general electrical laws.

The advent of electric lighting introduced comparatively heavy currents of great intensity, and new terms had to be coined to suit the altered circumstances. The names of electric units are perplexing to the uninitiated, failing to convey an idea of their meaning, being adopted from the names of well-known electricians and mechanicians, who have left their "footprints on the sands of time." I shall only use a few of these terms, what we may call the practical every day units, namely :—

The Volt, as the unit of electro-motive force.
The Ampere—current.
The Ohm—resistance.
The Watt—power.

We use these units as we use a foot as a unit of length, or a pound as a unit of weight : something to compare amounts or quantities with. Using the flow of water through a pipe as a familiar illustration, the *Volt* may be regarded as the pressure or fall given to the water ; the *Ampere* to the quantity flowing ; the *Ohm* to the resistance or friction of the pipe to the flow of water ; the *Watt* to the mechanical power exerted. To deliver an increased quantity of water in a given time you must increase the pressure or enlarge your pipe; so with electricity, you must increase the electro-motive force, or enlarge your conductor.

The *Volt* may be defined as "such an electro-motive force as would cause a *current* of one *ampere* to flow against the *resistance* of one *ohm*."

The *Ampere*, "such a current as would pass with an electro-motive force of one volt through a circuit whose resistance is equal to one ohm."

The *Ohm*, "such a resistance as would limit the flow of electricity under an electro-motive force of one *volt* to a current of one *ampere*."

The *Watt*, "the volt-ampere or unit of electrical work."

Electro-motive force may be defined as the power which a battery or dynamo possesses of causing the transfer of its current from one place to another, or of overcoming resistance. The electro-motive force of a Callaud cell is slightly over one volt, and for rough work may be called one volt. The resistance of a conductor is directly proportional to its length and inversely proportional to its cross section. The conductivity of a wire is the reciprocal of its resistance ; thus if a wire has a resistance of 1 ohm, the conductivity is 1. When the resistance is 2 ohms, the conductivity is ½. When it is 4/5 of an ohm, the conductivity is 5/4, and so on.

In 1821 Ohm established his celebrated law : "That the strength of the current was directly proportional to the electro-motive force, in the circuit, and inversely proportional to its resistance." Ohm's law is familiarly represented thus : $C=\frac{E}{R}$, where C represents current in amperes, E the electromotive force in volts, and R the resistance in ohms.

$$\text{If } C=\frac{E}{R} \text{ then } E=C\times R, \text{ and } R=\frac{E}{C}$$

By this law, if you know two of the quantities you can easily find the third. For example—(1) What is the strength of the current in a circuit consisting of a wire whose resistance is 5 ohms and a battery whose electromotive force is 2.3 volts, and internal resistance 4 ohms?

$$C=\frac{E}{R} \text{ or } \frac{E \quad 2.3 \text{ volts}}{R \quad \underset{\text{(wire-battery)}}{5\times4}} = .225 \text{ amperes.}$$

(2.) What electro-motive force is required to send a current of 2 amperes through a circuit offering 1.6 ohms resistance?

$$E=C\times R=2\times1.6=3.2 \text{ volts.}$$

(3.) A battery whose electro-motive force is 6 volts and internal resistance 2 ohms produces a current of 1.4 amperes. Through what external resistance is it running?

$$R=\frac{E}{C}=\frac{6}{1.4}=4.285-2=2.285 \text{ ohms.}$$

From these plain examples it is evident that any one familiar with the application of Ohm's Law can feel the pulse and prescribe for his wires at any time on short notice.

A galvanometer is an apparatus for measuring the strength of an electric current by the deflection of a magnetic needle. It depends for its operation on the fact that a conductor, through which an electric current is flowing, will deflect a magnetic needle placed near it, and free to move. This deflection is due to the magnetic field caused by the current. The action was first discovered by Oersted. A wire over a needle deflects it to the right or left, according to the direction of the current. By doubling the wire under the needle the effect is increased. In extremely sensitive galvanometers very many turns of wire are employed, in some cases amounting to many thousands. These are termed high resistance galvanometers. Low resistance galvanometers often consist of a single turn of wire or a strip of metal and are used for measuring heavy currents.

In England and the Continent the telegraph wires are tested daily for insulation and resistance. They are run over rapidly with a detector or a tangent galvanometer and the deflections tabulated. A battery is first joined up with the galvanometer and a known resistance, say 5,000 ohms, and the deflection noted, say 45 degrees—this is called taking the constant of the galvanometer. The lines are then tested with distant ends open, then distant ends closed, and deflections noted. The resistance is worked out thus: Supposing with the resistance of 5,000 ohms a deflection on the tangent side of 100 divisions were obtained, with line in circuit and grounded at distant end 60, and when distant end open 30 divisions. As the greater the resistance the less the deflection, consequently as 60 is to 100 so is 5,000 to the resistance required, 8,333 ohms conductivity resistance ; and as 30 is to 100 so is 5,000 to 16,665. Be careful to remember that these are tangent divisions, not ordinary compass degrees. Date, state of weather and temperature are also recorded for comparative purposes. Any variation from the normal record is gone over again with a Differential galvanometer or a Wheatstone bridge, and the defect rectified at once. By this means troubles are anticipated before they become serious. In testing be careful not to have galvanometer near enough to be affected by other charged wires or masses of iron, such as dynamos, engines, boilers, etc. Where this cannot be avoided place galvanometer in an iron sheathed box.

Electric light companies are supposed to test daily with a magneto, but that does not reveal anything very definite, it will only tell if circuit is dead open, or that there is a leak in the line. The magneto will not reveal a short circuit, nor locate an escape unless line is tested in sections. The telephone companies also call up customers and test lines with magnetos, but unusually heavy resistances may creep in and not be detected by this means, and nothing will be done till the line offers sufficient resistance to attract attention. Electric light companies could test with a small battery and galvanometer, or a milliampere meter in day time for resistance, using magneto for insulation tests. Telephone companies could run over their lines during the silent watches of the night when customers are sleeping. Electric railways should take the resistance of all their circuits at various points, say every quarter of a mile, and at junctions or intersections when first installed, and at regular intervals afterwards. By so doing weak spots, such as broken bonds, defective grounds, etc., may be detected at once and remedied. An occasional run over the lines with volt and ammeters also is recommended. It is well to test with as small a battery as will suffice, as heavy currents sometimes fail to indicate faults, the current welding or expanding the weak spot, or jumping the gap. Lines will sometimes apparently test better in wet weather than in dry, the escape reducing the apparent resistance and rain assisting the conductivity of bad joints. In testing for insulation, as heavy a battery as convenient should be used, especially on short lines, unless you have an extra sensitive galvanometer. Long lines will appear to test worse than short ones. When insulation resistance is secured, it should be reduced to a mileage resistance or it means nothing.

With a good galvanometer and a suitable resistance box it is an easy matter to do plain testing, but difficult problems present themselves which try the metal of the tester. A dead ground or a well defined cross may easily be located. But usually grounds have considerable in them, and crosses do not always make good contact. An example or two from actual practice may be permitted. Wire No. 20, running east from Hamilton, was grounded between Hamilton and St. Catharines. The wire in good condition measured 560 ohms to St. Catharines or 16 ohms per mile. The line measured through the fault with distant end open 4,000 ohms. Another wire, No. 19, of similar resistance was looped at St. Catharines and measured through the fault on 20 with Hamilton end of 20 open, which went 4,800 ohms. The loop was then measured to prove former test and went 1,120 or twice 560. We now add the two first tests together, 4,000+4,800=8,800. We deduct third, leaving 7,680 as remainder. This represented the resistance of the leak, measured *twice*, or 3,840 as resistance of the leak. Now to locate it—the first test stood at 4,000; deduct 3,840, leaves 160, or 10 miles from Hamilton; this proved by the 2nd measurement also. Where distant office uses a galvanometer, a second wire may be dispensed with, but where practicable the tester should prove his own measurements. As a single wire this would measure, 1st from Hamilton, 4,000, then from St. Catharines, 4,240; added together, 8,240, less resistance of wire in good order, 560, or 7,680 for fault twice measured. In this instance the repairer found a broken stay wire touching dry sandy soil, at the distance indicated. Measurements made without a knowledge of the usual conditions of the wire are sometimes misleading, owing to extra resistance not looked for in the measurements.

To measure a cross, it is safer to treat it as a leak to earth. You thus eliminate any resistance which may be in the cross. Ask an office beyond the cross to open one wire and ground the other. First measure the loop through the cross, then each wire through the cross to distant ground. Thus:

Nos. 1 and 2 crossed between you and an office 25 miles distant. No. 1 is opened and No. 2 grounded at that office. Usual resistance of lines, 16 ohms per mile, or 400 to distant ground.

Loop measures 384, No. 1 to ground measures 400, No. 2 to ground 400, indicates no resistance in cross. Half the resistance of loop divided by 16 gives the distance as 12 miles from your end. If wires are of different resistance the case is a little more difficult. Say No. 1 went 20 ohms per mile, and No. 2 went 16, the meaaurements would be, loop 432; No. 1 to No. 2 ground 448; No. 2 to No. 1 ground at distant end 452; add together make 900, the resistance of both wires. Then 36 (o and 16) into 432 goes 12 miles. If any resistance in cross it will appear in excess of measurement and should be deducted to get distance. Take an example of two wires crossed by a high resistance, say a mass of wet kite tails. Each wire measures 400 to distant office, each wire measured through the cross to distant grounds 8,400, indicating 8,000 ohms in the cross. Now measure the loop with distant ends open, it goes 8,200. Deduct 8,000 for fault and divide half of 200 by the mileage for distance of fault, or 6¼ miles.

Some time ago we noticed an unusual amount of resistance in wires leading out of Hamilton (they had not been tested for a long time). On testing lines in sections we located the excessive resistance within the city limits. On closer inspection we found some rusty joints which measured immensely, some going as high as 1,100 ohms, or 55 miles of the wire. These were cut out and lines brought within reasonable limits. The safe rule is to keep down resistance to its lowest point. We must have a certain amount of resistance in our circuits, which we may call useful resistance. But useless resistance is a waste of current and consequently a waste of money, an expenditure which pays no dividends, but which, in time, may ruin the company. Remember that every watt costs something to produce. A comparison of the power exerted and the light and power delivered would be interesting, Eliminate therefore all useless resistance and remove all leaks to earth and you get more light and power at less cost.

Referring to Ohm's Law again we found that if we know two of the conditions of a circuit we could find the third. We can then by use of volt and ammeters determine the resistance of our circuits when hot, and with a galvanometer or milli-ampere meter resistances can be accurately measured when cold. Resistances hot and cold differ considerably. The resistance of wires increase with heat, while the resistance of carbon filaments decrease. It is well then to know and tabulate both resistances, or mistakes may be made. As the resistances of wires, lamps, dynamos, etc., can easily be ascertained and tabulated, any deviation from the standard should be sharply looked after. A decrease of resistance means a short circuit, an increase of resistance means a bad joint, or a loose or dirty connection, and as joints become uncovered and corroded, and connections will become loose and dirty, constant vigilance is essential for *safety* and economy.

A word about leakage to earth. Telegraph and telephone companies have to depend upon their insulators entirely, but light and power companies sometimes depend upon the insulation of their wires and are not as careful as they might be about other insulation. The so-called insulation of wires in many cases are rather delusive in wet weather and the only safe rule is to act as if they were naked wires. Almost any kind of insulated wire will be all right in dry weather, but after a heavy rain, if the wires are not kept clear by proper insulators, heavy leaks may be detected. Some of the so-called weatherproof wires are little better than underwriters. Samples of wire should be tested for insulation, for waterproof and for fireproof qualities. For ordinary insulation, test with an induction coil, giving at least an inch spark. Attach one end of the sample to be tested to one of the secondary poles and hold the wire by its insulation. If defective, a shock, more or less severe, will be felt. Fingers should be moist and delicate for this test. To test for waterproof qualities, soak a sample of wire in a metallic tank or tub of water with metal plates for 24 hours. Attach a heavy battery to one end with a delicate galvanometer. Attach other end of battery to metal of tank or plate. Other end of wire tested to be left dry and disconnected. If wire is defective galvanometer will deflect. A good magneto may be used instead of galvanometer and battery.

Fire proof qualities may be tested by passing currents of various strengths through wires for certain length of time. Every coil of wire should be tested for resistance before being used to avoid using wire with flaws. A first-class wire should have the insulating and waterproof qualities of rubber or percha, be fireproof like abestos, not affected by exposure to any and all kinds of weather, be durable and cheap, but I don't know where this wire may be found.

I have endeavored to explain the method of testing telegraph lines, and the application of the same to other electric wires; and urge the regular and systematic testing of all circuits and appliances, believing that by so doing more satisfactory work will be done, greater safety insured, and more money earned by the companies.

Mr. McFarlane: I think we have been all entertained by the paper which Mr. Black has read. We have all, more or less, to plead guilty to his indictment, especially on the question of insulation. I think if the companies looked more closely after that particular they would make better dividends. I know that in the telephone business we started out with the idea that insulation was not necessary. I experimented on lines without insulation, and found it worked all right on lines ten or twenty miles long, but for long distances the result was different. We then gave up that idea, but we have not yet reached the point indicated by Mr. Black, of perfect insulation. In travelling over Canada and visiting its various towns, I think I can say that there is no place where this matter is looked after properly. I think if a little more engineering work were done in the way of testing, and in completing insulation where possible, it would be found more profitable in the long run. Therefore, I think Mr. Black's paper is one which ought to be carefully studied, as it is highly valuable in this connection.

Mr. Neilson: There is one point on which I have to take issue with Mr. Black. He spoke of testing the telephone lines during the "silent watches of the night." I might say that the silent watches of the night with us would run very far into the business of the day before we got through. In this city, with 4000 wires, it would be necessary to put on a very active man to get through with the necessary work. I do not know of any telephone company that does the testing of its wires periodically every day or night, and I doubt very much whether it would be possible, without a very large staff indeed. You will see that it would take quite a few minutes to put the wire on and simply take the constant. The paper brings to mind many incidents connected with my telegraphic experience. I am probably the oldest telegraph operator present, and I remember the time, away back in '54, when men who talked about testing lines were simply considered humbugs. I can remember when I first obtained a galvanometer, and tested some lines of the Dominion Telegraph Company. First, we had a ground on the line from here to Hamilton, and, with fear and trembling I announced that it was somewhere near the Humber. A man drove out there, and found about half a mile of the line floating in the lake, so we were quite satisfied with the test. Another day, we discovered a ground on the line between here and Oakville. The test showed that the ground, measured in the ordinary way, was away up past Hamilton, even away up on the mountain there (laughter), so I then used the loop test, after which I announced that it was a little bit this side of Oakville. We sent out a first-class lineman but he could not find it, and he drove back again, with the same result. The general manager and myself drove out again, and found the difficulty was caused by a cross with the wires of the Montreal Telegraph Company this side of Oakville, and that Company, with their usual kindness in such matters, had immediately grounded their line at their Toronto office, so you can see how the measurement was obtained. I remember another instance where I tested a wire, and announced that the ground was twenty miles east of Toronto. A Frenchman went out, and when he came back he could not express himself fully enough on the wonderful ability of that machine. He said, "I find it just at the mile post." He considered that that beat anything in the way of a test he ever heard of. I have much pleasure in moving a vote of thanks to Mr. Black for his very clear and lucid paper on the subject. It is something we ought to study up more fully than we have done, and I hope that the young members of the Association, at least, will do so.

Mr. Thornberry: Many of us electric light and telephone men have been in the telegraph business, in the old days when insulation was not considered of any practical value at all. I think it was a telegraph company in Toledo, which in those days, when insulators were not used, hung their lines upon the fences, and they swore up and down that those lines worked better than the ones that were insulated. I think the question of insulation for light conductors is a very important one. I think the manufacturers are doing their best to produce cheap and good wires, but owing to the expense, except in isolated cases, we must depend on insulators outside of the question of insulating wire. Construction is very important now, and I think we can learn from such papers as we have just heard a great deal that is valuable. I beg to second Mr. Neilson's motion for a vote of thanks to Mr. Black.

The motion, having been put to the meeting, was carried.

Mr. Black: With regard to what Mr. Neilson has said, I did not intend that every telephone office or telegraph office should test its lines every day or night; I said "periodically testing them," which meant if you run over your 4,000 wires once in a fortnight that would be quite sufficient to keep one man going in a large place like this, testing each line at regular intervals. Of course, if they get them underground, the testing is not so important; where there are so many connections there is sure to be some little leakage somewhere.

Mr. Thomson: I have been waiting for someone to take up the cudgels for the electric light men. Mr. Black says they pay more attention to seeing that the wires are covered with some kind of covering than they do to insulation. I certainly think his information must be far-fetched in this respect, because I think from the time the electric light companies were started, it has always been with them a great object to get good insulation.

Mr. A. B. Smith: I presume that Mr. Thomson is speaking for Hamilton. I am in a position to speak for a good many other places, and I have to say that insulation is looked upon as only a secondary consideration. It is "get there" anyway.

Mr. Thomson: I think if the telegraph and telephone men would pay a little more attention to insulation it would be well for them, too.

Mr. McFarlane: I do not mean it as any reflection upon the electric light men, but I have been in places where I was surprised that the electric light inspector would allow such wiring to be done.

Mr. Smith: Not in Ontario. (Laughter.)

Mr. McFarlane: Yes, in Ontario.

The President: In the days when insulation was not considered of any account, we used to run bare wires. The Brush Company ran their circuits, 16, 18 and 20 arc lights, on bare wires, but it was very soon discovered that it would be just about as well to have something on them. There is no doubt whatever that a good deal of the insulation that has been put upon electric light wires has been of no account at all; in my opinion the wires would be very much better without it—not that I am advocating bare wires at all, but much of the so-called insulation means simply false security, and is the cause of a great deal of trouble. For instance, if the wires were bare, and a contact came on them, it would be at once discovered by various tests made during the day for grounds. But with the so-called insulation, where there may be a hundred crosses one after the other, the tests do not show them, until a rainstorm comes along, and they all develop at once, causing much trouble. Mr. Black spoke of the importance of measuring the resistance of wire as regards quality. That is a most important point, and it has been impressed upon me in a very forcible manner in the construction of electrical machines; unless the wire is tested very carefully, one half of the good result is lost. One dynamo may be built, and run perfectly, with a large out-put for a reasonable amount of power, and run cool. Another machine may be built from the same patterns, the same wire, the same quality of insulation on it, and you cannot get from it one half of the results, and the concern gets hot enough to burn itself up. That is a point which builders of machines will have to consider more. I have no doubt that in a rough manner the quality of the wire is examined into, but more depends upon good conductivity than anything else in the business. It means the saving of a good many dollars in a year in the question of fuel. There is another point I would like to hear discussed, and that is, the testing of electric light lines for bad connections or faulty circuits. Mr. Black suggested the testing of such lines daily for resistance. This I think he would find impracticable for the reason that the measurements would have to be made through the carbons of the lamps. This would introduce an ever-varying quantity, as some of the carbons might be short with burnt ends, making perfect contact. When many of the lamps were newly trimmed the resistance from poor contact or dirty points might measure away up in the thousands of ohms, in fact approach an open circuit. That is the difficulty that would have to be contended with in a test for resistance. It is an important matter to ascertain the condition of a circuit, and if there is an electric light man here who knows of any means of demonstrating that condition of a test, it would be of great advantage to the fraternity.

Mr. Black: In reply to Mr. Thomson, I knew of the case of an electric light company having their wires—one of these "undertaker's wires," as they are called—lying on the cornice of a building weeks at a time, during all kinds of weather. In a country town where I was, I saw one of these underwriter's wire lines running into a church, at an angle of 45 degrees, without any insulator at the window, or anything to prevent the dripping of the rain from the wood, and then turning up inside again. Now, the amount of rain that ran through there might set the casings of that window on fire.

Mr. Thomson: I am afraid an electric light company did not put that in—that was a farmer's installation, not an electric light company's.

The President: Mr. W. A. Tower, of Toronto, will read a paper on "Underground Construction."

UNDERGROUND CONSTRUCTION.

It is only within the last six or seven years that underground conduits for electrical purposes have been constructed to any extent, although as early as 1808 Soemering, a Russian scientist, exploded mines electrically through an underground wire a mile long, and in 1837 Cooke and Wheatstone operated the first practical telegraph system in the world by means of underground wires. At that time the art of insulation was in its infancy, and the underground was soon abandoned for the overhead wire. Within the last few years, however, the insulation of wires and cables for underground work seems to have been nearly perfected, and at the present time we have reason to believe that we will never be troubled on that score if proper care is taken in manufacturing and laying the cables.

As my experience has been chiefly confined to underground construction in connection with telephone work, the descriptions in this paper refer to that class of construction, although electric light cables could be put in the same style of conduit.

The first work of burying wires in America was done in Washington, D. C., but I believe the system did not work satisfactorily, and is to be, or has been remodeled. The next work of any importance was done in Chicago, when they adopted the drawing in system, the only practical system for telephone work at the present time.

A drawing in system is one where any number of ducts can be laid and used at any time without having to dig them up, or having to lay the cables at the time the conduit is laid. This system does not necessitate the use of any particular material or make of conduit—of which there are a great many; the principal ones are,—1st, iron pipe; 2nd, cement-lined iron pipe; and 3rd, the Wyckoff. There are several others, but most of them have been discarded for various reasons, while others I have never seen and cannot give any description of them.

In building an iron pipe conduit, after the trench has been dug, a layer of concrete about three inches thick is laid, wide enough to allow an inch or more between each pipe, and three inches on each side. A row of pipes is then laid. The pipe lengths vary from 14 to 22 feet, and are screwed together by regular threaded couplings. After this is done, concrete is put on, filling up the spaces between the pipes and the three inches on each side. The concrete is then levelled off about one inch above the pipe. Another row of pipe is then put down, and the process repeated until the proper number of ducts has been laid. The top layer of pipe is then covered with three inches or more of concrete, and the trench filled in.

The cement lined pipe comes in lengths of about 8 feet with bevelled male and female ends, and is laid in the same way as the iron pipe. The joints are made by bringing male and female ends together, and covering the junction with neat cement.

The Wyckoff conduit consists of pieces of thoroughly creosoted wood, about 8 feet 4 in. long. 4½in. in diameter, with a three inch hole through the centre, the ends counter-bored and tenoned. There is first laid an inch and a half board in the bottom of the trench, which is wide enough to hold the proper number of ducts. The ducts are then laid on this, layer by layer, the joints being made by joining the male and female ends about half the length of the tenon, when hot pitch is poured on, and the lengths then driven together. After the ducts are all laid, a 1½″ board is placed on top to protect the ducts from the picks of workmen digging across the line of the conduit. This all appears very simple to those who have had no experience with this work, but some of the difficulties which have to be overcome are by no means trifling. In the first place, after deciding upon the route to be followed, it is necessary to find out whether there is room enough on the street to lay the conduit, as the gas mains, water mains and other pipes may have been laid before the conduit was thought of. The Engineer or Supt. of construction applies to the city and gas company for the location of their mains, which information, as a rule, is given very graciously, but in three out of five cases the position given is not correct within two or three feet, and about the only use made of the information is to tell on which side of the street the mains are, and, consequently, test holes have to be dug to locate the pipes before the work can be started. As a general rule the bottom of the conduit is put below the level of the gas mains, and when a corner is reached it is often necessary to carry part of the ducts over the mains, and part under them. In some of the larger cities of the States where there are two or three gas companies, the conduit trenches at street intersections often have to be as deep as ten feet, on account of the numerous pipes that cross one another at such points. The manholes are usually located at street intersections, and consist of chambers about 7 feet long, 5 ft. wide, and 7 ft. deep with brick walls laid in cement, and a cast iron head and cover, generally made to bolt down tight to keep out water. After the conduit is laid and manholes built, an entrance must be obtained to the telephone building, which too often has been built without proper consideration for the handling of cables. The largest telephone exchange in the States has this fault; the first cables were pulled into the bottom duct, and it was found that it would be impossible to ever get at them again. The consequence is, that if a cable gives out it will have to be left, and the duct sacrificed. I do not think there are two exchanges which have the same appliances for handling cables, every engineer having a different idea as to how it should be done, and as yet a perfect system has not been adopted anywhere.

In pulling in cables, we first have to get a rope through the duct. This is done with wooden rods, about four feet long, equipped with malleable-iron couplings. A rod is inserted into the duct which is to be used, a second one jointed on to it, and both pushed into the duct; this process is repeated until the rods extend to the next man hole. A rope is attached to the first rod, and the rods and the rope pulled back into the first man-hole, and the rods uncoupled as they are pulled in. The rods are handled quite easily, two men being able to rod 400 ft. of conduit in about fifteen minutes. The rope is then fastened to an iron clevis, about 10″ long, made to fit the cable and riveted on to the end of it, the reel of cable being on the holder. The cable is then ready to pull in, which is done with a winch geared to an upright shaft with a sliding drum, and so arranged that the drum can be placed exactly opposite the duct through which the cable is to be drawn, thereby avoiding pulling the cable around or over any corners of the conduit.

After the cables are in, the splicing is to be done. This operation requires the greatest of care, and only thoroughly reliable men should ever be employed to do this work. In making a splice, the cables from each way are bent into their proper place in the man-hole, and then cut to the proper length, which allows the end to lap about a foot. The lead is then stripped off each end the length of the lap, and a piece of lead pipe, large enough to cover the wires when spliced, is then slipped over one of the ends; the wires are separated in pairs and turned back as far as the lead is stripped. Two pairs of the bottom wires, one from each end, are then taken, and the insulation stripped off, care being taken not to nick the wires. A paper sleeve is then put on one end of each wire, the wires twisted together, and the sleeve slipped back over the junction of the wires. After all the pairs are joined in this way, they are boiled out with hot paraffin, to vaporize any moisture that may have been absorbed while making the splice. A piece of paper is bound around all the wires to keep the paper sleeves in position; the lead sleeve is now pulled over the splice, and a regular plumber's joint wiped.

If a workman is careless in making a splice he is liable to leave a wire open, or he may not boil it out thoroughly, and so leave enough moisture there to bring the insulation of the cable very low, and it is difficult to locate such a fault exactly without opening splices until it is found.

Before a splice is started, the cable is tested back to the office, or to the point from which it starts, for open and grounded wires; the length to be spliced on is also tested in the same way, and if any such wires are found they are spliced together, so that although there might be a faulty wire in every section of the cable there would still be only one bad wire from end to end. If the testing were not done, a faulty wire in one section might be spliced to a good wire in the next, and so on, in which case, the more sections of cable the more faulty wires there would be in the entire length. After all the splices are made, and the pole or building terminal and office terminal put on, the wires are tested out and put on corresponding binding posts at each end. A capacity and insulation test is made, and if it is up to the standard, the cable is ready for use. At present the insulation must be at least 500 megohms per mile, and the capacity at most .08 microfarad per mile.

The subject of underground construction is too large a one to be treated in any sort of detail in such a paper as this, but if any of you care to follow the subject further you are heartily welcome to inspect the underground work of the Bell Telephone Company in this city.

DISCUSSION.

The President: I would like to ask Mr. Tower if he found in the course of his experience any bad effects from the leakage supposed to come from the grounded lines of the street railway? I have heard that there is a certain amount of trouble caused in that way. The point is one which it seems may presently become important; I suppose it will be a question for the telephone company to say whether they can fix the responsibility on the street railway.

Mr. Tower: There is certainly a difference of potential between some of our cables. There is one case, where we had a separate section of cable, where by touching this section we got a spark as large as you get from an ordinary telephone generator, but as far as ascertaining the point you speak of, it has not been there long enough yet, but there is certainly a difference between our cables underground.

The President: Have you found that the quality of the conduit made any difference? Is one what you might call a better insulator than the other? Would that spark be due to induction or a leaky current?

Mr. Tower: It is supposed to be due to the cable being partially grounded at some points. Of course, I have not had very much experience in that. I do not see that any one particular kind of conduit would make any difference. The only way in which we hope to overcome it is by grounding our cables as often as is necessary in the manholes—trying to keep the same tension in the manholes. It is impossible at present to say whether it will be successful.

The President: The reason I ask is this: the question of underground conduits is becoming very interesting, not only to the telephone companies, but to other companies engaged in the distribution of electrical currents. There are two kinds of conduits, as you say, that might come into use—one in which the conductor is insulated, and the conduit is as good as the ground, and the other formed of non-conducting material through which bare wires may be drawn. I do not know whether conduits of that kind give remarkably good results—those made with creosoted paper, through the pipes of which bare wires have been run. Any information from those who have had practical experience would be of great value to those who are in the business, or who may be in future.

Mr. McQuaide: I can give you a little information. I only know of one place in the United States where they have been tried, and it has not been a success. The parties who furnished that material are rivals in business of mine, but nevertheless, I think I am right in saying that in Minneapolis, where it was tried, it has not been found a success. They tried it with feed wires, but they had to keep one man all the time taking it up. It was a disastrous failure. I do not know why it was a failure, but it was all taken up. There are a good many reminiscences in connection with the conduit business, not going quite so far back as those of the telegraph business; but about fourteen years ago, when the electric light first began to be thought of some general use, it was thought that nothing would do but something that was a non-conductor, but opinions seem to have advanced, until now they seem to have reached a point when it seems to be the idea, both of telegraph, telephone and electric light companies, that the only thing you want is a hole in the ground, and let the wire men do the rest.

The President: There is another point on which Mr. Tower might enlighten us, and that is the use of creosoted conduits, the effect they have on the lead covering of the cable.

Mr. Tower: There are many opinions on that subject, which has been pretty well ventilated. Some claim that it does not affect the cable, while others are taking it out, claiming that their cable is being injured by it, so I do not care to express any opinion upon it.

Mr. A. A. Wright: Did I understand the gentleman correctly, that all we had to do was to put the wire in the ground, and it was all right? (Laughter).

Mr. McQuaide: I said that all that was necessary was a hole in the ground. Cables can now be made to do just as well if laid in the ground. Of course they have to be prepared in a special manner. All the conduit is for is to protect the cable, to enable you to draw it in and out for the purpose of repairs.

Mr. Starr: I would like to ask one question. In these conduits, do you find any electrical action between the grounded wires of the street railway and the metallic circuit that is insulated?

Mr. Tower: The trouble is the action on the lead casing of the cable. To my knowledge we never had any trouble on the wires inside the cable, but it is the action that sets up between the different molecules on the lead covering of the cable.

Mr. Starr: If they were insulated, even with creosoted wood, would not that prevent any such action?

Mr. Tower: I have had very little experience of that, and am hardly able to say.

Mr. A. B. Smith: Mr. President, I would like to move a vote of thanks to Mr. Tower for his paper, which, I am sure, has been very much appreciated by those in the business.

The motion was seconded and carried.

The President: The old telegraphers have been indulging in reminiscences of the way in which they used to do it in the year one, and it has occurred to me that it would be interesting if our friend Mr. Smith would give us some idea of what is being done at present, in the most modern developments of the use of the electric current for telegraphy.

Mr. Smith: I did not expect to be called upon in this way, and I do not know whether I can say much that will be of interest to you. We have been indulging to such an extent in reminiscence that it puts one in mind of an old-time camp meeting. When a practical electrician, or anybody engaged in the electrical business, begins to talk about the way things were done fifty years ago—drop him. (Laughter). Talking of batteries, we have made a new departure in the head office here of the G. N. W. Telegraph Co. We have entirely dispensed with the use of batteries, and have adopted generators, and, although the system is incomplete, being simply in a transitory state, still it is far enough advanced to enable anyone who wishes to see it to do so, and they will be very welcome. After a good deal of hunting around and tracing up all we could find relating to the subject, and inquiring into different systems, we finally adopted what is known as the motor-generator system, or the transformer. In some of the large cities of the United States (there are none here, ours is the first installation in Canada) they have a motor driving a lot of generators at different potentials; others use an engine, and that means a good deal—it means duplicate machinery for everything. In looking the thing over, we came to the conclusion, being very favorably situated here as regards power, having two power companies, that at no time would we be likely to have to shut down for any cause other than a fire in our building, which, of course, is a very remote possibility. I might just say that the machine we have in use was built by our President, and he, probably, could tell you more about it than I can. However, the pattern adopted is the one horse power style, ring armature, having 32 sections—16 are on the motor side and 16 on the generator side. These coils are separated from each other by very thick wooden and mica insulation. They are arranged for 110 volt current to all the motors, and on the generator side for 75, 150 and 300 volts. Well, as I was saying, some of these have been put into practical use and have quite exceeded our expectations so far as efficiency and comfort goes; we get a better current with less trouble. In addition to that, we are running our locals or sounders, short circuit instruments in the office, on which we have a six volt machine and about one hundred amperes of current. Of course it meant a great many changes in the office wiring and the switching apparatus, and if you were interested at all in knowing how the connections were made, I might be able to draw you something on this blackboard. (Diagram shown on blackboard.) In the old days we have heard so much about, it was never customary to work more than four or five lines out of one battery; to work more than that was to use up the battery and you could never get very satisfactory results. In our office we have displaced some three thousand cells, and what I was wanting to get at is this—practically the capacity of these machines is unlimited; you can load them up "out of sight." We are now working about fifty of our long lines out of one of these small machines. The machines are slow speed, running at about 900, taking an ampere and a half of current at 110. I do not see any reason why they should not run forever.

Mr. McFarlane: I would like to ask Mr. Smith to give us some idea of the economy of that apparatus, what it does away with, what it costs, &c.

Mr. Smith: That depends a good deal upon what you pay for power. A plant such as I have described takes between two and three horse power.

Mr. Kammerer: If the dynamo is running, furnishing current to the line, if you find the lamp glow you take out the plug; that takes out the current from your line; how is that line tested?

Mr. Smith: We simply leave it out until the ground is taken off. We know if that lamp glows that the ground is close by; there are a dozen different ways of testing.

Mr. Kammerer: It throws that line out of circuit?

Mr. Smith: Yes, but if you were in the telegraph business you would know that that does not affect it very much. (Laughter.) We have lots of wires to fall back on.

The President: Do you use these dynamo currents for testing purposes. Perhaps that is what Mr. Kammerer meant to ask?

Mr. Smith: Yes, certainly we can.

The President: That closes the programme for the afternoon, but Mr. Rosebrugh will now by means of a stereoptican project upon a screen and an electric arc show you its operation in an arc lamp.

The exhibition proved to be a revelation to most of the members and deeply interesting.

THE DINNER.

At 8 o'clock in the evening the members of the Association to the number of about fifty dined together at McConkey's restaurant. The tables were tastefully arranged and decorated, and the excellence of the menu was the subject of many compliments bestowed upon the worthy restaurateur. Excellent music was discoursed throughout the proceedings by an Italian band.

Upon the removal of the cloth, the President said: It has been understood that this gathering is entirely informal, and there is no toast list; yet I feel it my duty to call upon you to fill up your glasses and drink the health of Our Queen.

The toast having been duly honored, Mr. Martin favored the company with a song, which elicited a vigorous encore, to which he responded with another selection.

Mr. Starr: We have all heard the ruling just now of the President, in which he stated there were to be no toasts to-night, but we have had one, and I think there should be one more. I think every one who has listened to his address to-day, and who is acquainted with his indefatigable exertions in the interest of the Association during the past year, will gladly fill their glasses and join with me in drinking the health of the President of the Canadian Electrical Association.

The toast having been drunk with musical honors, three cheers and a tiger, the President spoke as follows:

Gentlemen of the Canadian Electrical Association: While it is not my intention, not being a speaker, to inflict upon you any speech on this occasion, I must not omit to express to you my very hearty thanks for the manner in which you have just responded to the toast given you by my friend, Mr. Starr. Having broken through the rule of the evening, we may as well go on breaking it, and I certainly have a great

(Continued on page 26.)

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Correspondence is invited upon all topics coming legitimately within the scope of this journal.

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THE second Convention of the Canadian Electrical Association has been held. Elsewhere will be found a synopsis of the proceedings with the papers that were presented and discussed. The gathering was a representative one in every respect. The leading electric light, telegraph and telephone men in the Dominion were present and took part in the proceedings. It may be said, that both socially and from a business point of view it was an unqualified success, and will be the forerunner of many more meetings of the greatest importance to the industry. The uniform excellence of the papers presented makes it almost impossible to particularize. We have given them fully in this issue with the exception of those by Mr. Rosebrugh ("Speed Control") and Mr. Breithaupt ("Long Distance Transmission"), which will appear in our next issue. A complete report of the proceedings, including verbatim copies of all the papers, will be printed and distributed to all the members of the Association. The paper by R. G. Black, who is a son of Mr. Geo. Black, manager of the G. N. W. Telegraph Co., Hamilton, and a graduate of the School of Science, Toronto, was a most timely one, and gives strong indications of a future full of promise for the youngest member of the Association. It has been suggested that at future Conventions the papers be printed in advance for the use of the members, so that they may be discussed intelligently and in a profitable manner. As it was, the business of the Convention and the various discussions were taken hold of in a vigorous manner, and both the work and the fun, at the sessions and the banquet, were handled with the vim that electrical men, of all other professions, are noted for. The members are to be congratulated that the "off-meeting," as it was termed, turned out such a complete success. It speaks well for the future of the Association, and without doubt the forthcoming annual gathering which is to be held in Toronto in the month of September, will eclipse in importance anything which has preceded it.

ENGINES FOR ELECTRIC LIGHTING.

I.

There are so many points to be considered in making a comparison between what are called high-speed and low-speed engines that it is not a simple matter to arrange the order in which they should be taken up.

In this article it is proposed to offer some suggestions on the question of the power developed by engines of the high-speed class. Before going further, the point should be determined at what speed does an engine become entitled to be called high-speed? At the Paris Exhibition of 1867, the Whitworth Co., of England, exhibited two Porter-Allen engines. The one was a condensing engine, of two feet length of stroke, which was run at 200 revolutions per minute; the other was a non-condensing engine of one foot length of stroke, and was run at 1,000 revolutions per minute. The engines were most skilfully designed, and the workmanship, like everything Whitworth made, was as near to perfection as could be had. The piston speed of these two engines was very much higher than any then in general use, and the one is probably ahead of anything yet in use. The speed of the piston, however, is not generally considered, although it must be used in the calculation of the power. An engine making two hundred revolutions per minute or over would, by most engineers, be called a high-speed engine, without reference to the length of stroke.

From 250 to 350 revolutions per minute seems to be usual speeds for these high-speed engines, and, as many of them are of about nine inches to one foot length of stroke, 600 feet per minute is a high piston speed for them. Power may be defined as pressure in motion. Inside the steam cylinder there is as much pressure in the cylinder head, as there is on the piston, but it has no motion, and consequently gives off no power. In the steam engine, then, the total pressure on the piston, and the speed at which it moves, are the two elements in the production of the power. At the commencement of the stroke the piston is close to one end of the cylinder and has no motion. Steam is admitted and pressure produced and motion. The motion at first is very short but increases, until at a point near to the middle of the stroke, the piston speed is as great and for an instant greater than that of the crank pin. The motion then gradually diminishes until the piston comes to a standstill at the other end of the cylinder.

As *horse power* is measured by the standard of 33,000 pounds lifted one foot high in one minute of time, the changes that take place within the *one* minute are apt to be overlooked. In an engine making 300 revolutions per minute, the piston has come to a standstill, in order to reverse its direction ef motion, 600 times each minute. The power given off varies even more frequently, as it is the product of the speed and pressure, and both of these are constantly changing. It will probably be more clearly seen if the changes are noted for a particular engine. Take the case of an engine having a cylinder 12″ diameter and 12″ stroke, and making 300 revolutions per minute, with steam admitted at 100 lbs. pressure, and cut-off at one quarter stroke. The horse power under such conditions would be about 94½ horse power, but if the pressure on the piston at mid-stroke, and the speed at which it is then moving be taken, the horse power would be about 255 horse power. In low-speed engines similar differences will be found, but it is questionable if the results of these differences are as great in low-speed as in high-speed.

The great effect of the weight of the reciprocating parts, that is of the piston, piston rod, cross head, and part of the connecting rod, is to reduce the pressure on the crank pin during the first part part of the stroke, while the speed is increasing, and to increase it during the latter part, while the speed is diminishing. This action tends very much to equalize the pressure on the crank pin. The effect of weight, in these parts, on the motion of the engine is far greater in high speed than at low speed; and in designing a high-speed engine the weight of these parts should always be taken into account. At mid-stroke these parts have attained their highest speed, and moving at same velocity as the crank pin, the pressure on the piston is at once conveyed to the pin.

From this way of looking at the matter it is plain that there is no steady power given by the engine. Its power is a series of perpetual changes, the average of which in the engine in question is 94½ horse power. The fly wheel is supposed to be a sort of reservoir into which the surplus energy may be stored, and drawn from it if required. This, however, can only be done by change of speed. These suggestions are offered as probable explanations of some of the complaints made by electricians of unsteadiness in motion or in power. The steam engine is not so perfect in its details as some suppose, and when tested by finely balanced and delicate apparatus, irregularities become apparent which could not be detected by the tests formerly applied to steam machinery. Increased power is obtained by increased speed of piston, whether that speed is obtained by longer strokes or by greater number of revolutions in a given time.

High speed engines require to have weight and strength in proportion to the greatest strains put upon them at any point of each stroke, and not in proportion to the average power. The admission and exhaust of the steam must also be specially provided for. The *admission* must be rapid and the cut-off *certain* and *positive*. In case of an engine making 300 revolutions per minute and cutting off at one quarter stroke, the steam valve opens, admits the steam, and closes again, in one-fortieth part of a second. The exhaust is opened and closed at each end of the cylinder ten times per second. There is often greater difficulty in getting rid of the exhaust steam than in admitting the live steam. Unless there be ample freedom for the exhaust to escape there is great loss of power from the exhaust steam having to be forced out. Small defects in the valve motion are apt to become of very serious moment when these defects are applied to operations that have to be performed in the fortieth part of a second, and power may be lost through failure to admit the steam properly. A little more admitted at one end of the cylinder than at the other will be sure to be seen in a jerkiness in the motion of the engine.

J. S. Parmenter, of Woodstock, has been granted a patent for a compound engine.

SPARKS.

Messrs, Meikle, Dyment & Son, of Gravenhurst, have recently purchased an electric lighting plant.

J. H. Etherington, of St. Catharines, will in future operate his carpet factory by electric power.

The Mimico Electric Railway Co. propose to make application to the township of Etobicoke, for a bonus of $10,000.

The breaking of a crank pin at the Niagara Falls Electric Light Works recently led to the resurrection of coal oil lamps.

A 300 light electric plant has been purchased by the Yarmouth Duck and Yarn Co., N. S., and will be used for lighting their mills.

Incorporation has been granted to the Ahearn Electric Heating and Manufacturing Company, of Ottawa, with a capital of $25,000.

The library of the Dominion Parliament will in future be lighted by electricity. The effect of the change is said to be most satisfactory.

A 40 horse power engine and steam boiler has been purchased by Mr. Bristol of Madoc, Ont., with which to operate his electric light plant.

The Eel Lake, Ont., mica mines have been purchased by the Thomson-Houston Electric Company, of Lowell. Mass., and will be at once put in operation.

There is said to be a likelihood of an amalgamation of the interests of the Gas and Electric Light Co., and the Incandescent Light Co., of Brockville, Ont.

Two 5,000 light and four 2,000 light dynamos are under construction by the Royal Electric Light Co., of Montreal, for use in their lighting station in that city.

Messrs. Tooke Bros., shirt manufacturers, Montreal, have installed a 400 light incandescent plant, and are also using electricity for heating their polishing and sad irons.

The number of passengers carried on the Montreal Street railway in December was 1,236,482; in the same month a year ago the number was 766,990; the increase was 469,492.

An interim injunction has been applied for to restrain the Davenport Street Railway Co. from crossing the G. T. R. tracks at Davenport Road or for laying tracks for that purpose.

The Standard Electric Light Co., of Ottawa, are about to install 700 lights in the Russell House, and have already installed between 300 and 400 lights in the Grand Union Hotel of this city.

The Detroit syndicate which recently purchased the Walkerville Street Railroad, are said to be considering the advisability of putting in an electric light plant in connection with their railroad enterprise.

The Toronto Street Railway Company has informed the city that the whole of its system will be operated by electricity this year. This will mean the re-paving of thirty odd miles of track at a cost of over $300,000.

A Montreal despatch states that Mr. J. F. O'Brien has entered an action for $15,000 damages, against the Bell Telephone Co., in consequence of alleged damaging statements in connection with his patent telephone index.

The forty-sixth annual report of the Montreal Telegraph Co. shows a surplus of property over the shareholders' stock of $151,824, and a contingent fund of $53,983. A rigid inspection of the company's lines shows them to be in good condition.

The Winnipeg Street Railway Co., pays the city annually $20 for each car used during the year, and in addition to all other sums, pays the city annually after February 1st, 1902, 5 per cent on the Company's gross yearly earnings. The company will considerably extend its lines during the coming season.

At the annual meeting of the London Street Railway Co., H. A. Everett, of Toronto, was elected president. These directors were chosen: J. C. Grace, Toronto; E. W. Moor, Cleveland; S. R. Breake, London, formerly of Toronto; T. H. Smallman, London. Mr. Breake will be manager of the road and secretary-treasurer of the company.

The Halifax Electric Light Company's new building will be 80 feet by 42 feet in size. The capacity of the steam plant is being largely increased. There have been added two incandescent alternating dynamos, each of 2,000 lights capacity. The arc light capacity will also be increased by 100 lights. Three power generators will be installed.

The question as to who should receive the lighting contract in Hamilton, at the expiration of the existing contract with the Hamilton Light and Power Co., which expires a year and a half hence, is already being discussed. It is said that the holders of the present contract have already submitted a proposal to the Council for its renewal. In the event of new tenders being asked for, it is believed that the Hamilton Street Railway Company will make a bid for the franchise.

A correspondent writes us from New Glasgow, N. S., that the Electric Light Company of that place are doing a big business this winter. They are lighting the three towns of New Glasgow, Stellarton and Westville. Their station is in New Glasgow, Stellarton being distant 3 miles and Westville 5 miles therefrom. The Thomson-Houston arc and alternating systems are used. The station is under the management of Mr. F. A. Bowman. Our correspondent states that there exists no such company as the "Westville company" as stated in the last issue of the ELECTRICAL NEWS, and that there is no room for opposition while Mr. Bowman holds the management of the New Glasgow Company.

(Continued from page 23.)

deal of pleasure in proposing to you the health of our worthy host, the Principal of the School of Practical Science, Prof. Galbraith.

The toast was enthusiastically received.

Prof. Galbraith : Mr. President and gentlemen—I need hardly say that it affords me much pleasure to be present with you this evening. I think that the advantages which the School of Practical Science will derive from the fact of your holding your convention there will be very great, that while you, for the time being, find with us accommodation, the staff will enjoy an opportunity, not too often afforded us, of coming into contact with those who are actively engaged in the practice of the electrical profession. I need hardly tell you that, shut up as we are, we have not many opportunities of coming into contact with the men who are doing practical work, and we feel that it is a great privilege to have such an opportunity of doing so as is afforded by your holding your convention within our walls. There is no doubt that the advances of electrical science will be great when all those who are interested in it, either as teachers and experimenters, or in the wider field of its practical application to the requirements of daily life, co operate and help each other in the work. There is no reason at all for those engaged in professional work attempting the same kind of work you are doing outside ; we could only succeed in producing a poor imitation. We have each of us our own field—yours the wide field of the world, ours the restricted one of the laboratory and lecture room, and the work that is carried on in each of those fields is in some respects very different. When we look over the advances of the science of practical electricity during the period since it first began to attract attention, I think we shall notice that during the earlier part of that period electrical investigation was carried on principally in the laboratory, and that most of the great laws of electricity were known as much as thirty years ago. But the advances which have been made since that time have not been so much in the line of scientific discovery as in the practical application of known laws, and the surmounting of difficulties which could not have been foreseen in the progress of laboratory work. I shall not attempt to give the names of the great discoverers in this line, for I am very poor at history of that kind, and I might find myself somewhat in the position of a little Sunday School boy, who, when asked to tell what he knew about Esau, replied something as follows : "Esau was also called Ishmael ; he built the Suez Canal, and wrote a book of fables called the Arabian Nights, the copyright of which he sold to a publisher for a bottle of potash." (Laughter.) I think you will be able to understand the distinction I wish to draw, that the men in both classes can help each other in doing the work that lies within their special sphere. One great difference between the two fields seems to me to be this : you find your spur to work in money-making ; that is to say, the great practical advances are, after all, for the purpose of making money. Now, the work of a professor is not expected to be for that object, and—I am very sorry to have to say so—he seldom disappoints that expectation. (Laughter.) However, we can work together something like some people in a neighbourhood down east, which some of you may know, are said to have done. The inhabitants of the County of Glengarry are, for the most part, Highlanders, and some of them are Presbyterians, and the others Roman Catholics. Notwithstanding this, they are very friendly and helpful to each other, and when the Roman Catholic portion of the community are in want of money for some of their objects, they do not hesitate to apply to their Presbyterian neighbours for a subscription, and in the same way, the Presbyterians would apply to them at other times for assistance in their projects, and they thus lived very happily and peacefully together. The parish priest was named Father Chisholm, and it is said that on one occasion, the Presbyterians having decided to build themselves a new church, and remembering that they had often helped their Catholic neighbours in various objects, a delegation of them called upon Father Chisholm to solicit a subscription from him to help in putting up the new edifice. Being ushered into his presence, the leaders of the delegation were for some time silent as to the object of their call, and at last His Reverence inquired, "Well, gentlemen, what is it that you want?" They explained the object of their mission to him. "What !" said he, "you expect me, a Roman Catholic priest, to assist in building a Presbyterian church ! Why ! what would the Pope say if he heard that I helped to build a Presbyterian church. No, no, I can't do it." The delegation was about to retire when, with a twinkle in his eye, his Reverence asked, "But what are you going to do with the old church?" "We are going to tear it down," said the spokesman of the party. "Oh !" says His Reverence, "then I'll give you a hundred dollars to help in tearing the old church down." (Laughter.) Now, that was a very amicable agreement, and the same sort of feeling should exist between the professors and the practical men—each should help the other, although one may sometimes help to tear down what the other has built up. By coming in contact with each other, a good many cobwebs, at all events, are torn down, and a much better understanding arrived at.

After toasts had been drunk to the health of the Secretary, the Executive Committee and the supply firms, and humorous addresses, songs, etc., had been given by Messrs. Neilson, A. A. Wright, Starr and others, a right jolly evening came to a close.

SECOND DAY.

The Convention was called to order by the President at 10:30 a.m.

The first order on the programme, the "Discussion on proposed Amendments to the Constitution," was held over until a later hour, in order that there might be a fuller attendance of members present when it took place.

Mr. A. B. Smith, was then called upon by the president to read the following paper, on "Free Wiring," in the absence of the author, Mr. J. M. Campbell, of Kingston.

FREE WIRING.

When arc lighting was first introduced in this country it was customary to put lamps and wires into the premises of the consumer free of charge. This was no doubt the origin of free wiring. As the business increased and incandescent systems of lighting were introduced, this practice was in a great many instances still continued. The simple wires of the arc system multiplied in number and size. The labor of installing these wires increased greatly. A better insulation was called for; incombustible fittings and better workmanship were the order of the day, until at the present time if interior wiring for any incandescent system is put in properly it requires good material and good workmen. Both of these cost money. In the face of all this a great many of the local lighting companies sail serenely on, wire up places of business and houses free of expense to the owners, charge the outlay to "Capital Account" and post it up in their books as an asset. The stockholders at the end of the year very likely obtain a stock dividend, and may consider themselves very fortunate if they are not called on to subscribe for a further issue of stock for extensions and improvements—unfortunately improvements to the property of other parties, and which if an asset at all to the lighting company doing the work, is of a very doubtful character—the kind of an asset which should be written off the books every year as a dead loss. Where do we hear of gas companies piping up customers' premises free of charge ? This is seldom if ever done, and yet in small towns the gas making industry does not seem to be any great bonanza, and it is generally conceded that gas light can be manufactured cheaper than incandescent electric light.

No doubt when an electric lighting plant is installed in a town a greater number of customers can be obtained by supplying all interior work free of charge, but when this is done the company is at the mercy of the consumer. On the slightest pretext the company are ordered to take out the lights and wires by the customer, who has not any financial interest in the stuff, and the company's asset of so many lights wired up, becomes a scrap heap of very little value. If the customers put in their own interior work, it saves a large outlay to the company in the first place. They then have an interest in it, and will not be inclined to cut off the current without good reasons. When pay day comes around, the collector will find that he has a different man to deal with than our friend with the free wires. By abolishing free wiring, a better class of customers will be secured. The lighting company's expense will be cut down considerably, as all changes and repairs can be charged for. There will not be so much capital invested, and therefore less dividends to pay, and on that account a cheaper service can be given. Give the people a perfect service at as low a figure as possible, and make them pay for everything inside of and including the main line cut-out.

The company may not secure quite as much business, but it will show a much greater net gain at the end of the year. The business will increase much quicker than the capital account, and by and by when a street circuit must be extended or a new dynamo put in, the money will be on hand to do it with, which would otherwise have been squandered on free wiring.

DISCUSSION.

Mr. Thomson : I must take exception to Mr. Campbell's idea ; I do not think he has ever come into competition with a first-class, live gas company, selling gas at about a dollar a thousand feet. He speaks also of small gas companies not being financially successful ; I think there are very few of them who are not, for it is a well known fact that the actual cost of producing gas is not greater than five or six cents per thousand feet, and if they get a dollar and a half per thousand feet, net, for it, I think they are getting a pretty good profit. The electric light is quite different. If an electric light company goes to an expense of $6,000 or $7,000 in putting in a large dynamo, I question if it is just right to have that machine sitting there doing virtually nothing, and whether it is not better to expend a few more dollars on free wiring. When I say "free wiring," of course I do not mean to say that you should go into a private house, and wire it from the cellar to the garret free ; in that case we should charge for it at cost price. The wires in that case, too, are mostly concealed ; but for stores I think in almost every case the cleat wiring should be done free. Of course there may be occasions and situations in which you can charge for that wiring, but cleat wiring can be done properly at a very small price. It is just run along the ceiling, and where there is approved wire does not require to be elaborately covered, or the floors taken up. I think that free wiring is a kind of booming that electric light companies take advantage of to increase their revenue, which there is no doubt it does do in a substantial way some times.

Mr. Yule : I am very much surprised at Mr. Thomson taking the stand he has taken. I do not see why electric light companies should wire free any more than gas companies do free piping. He advocates it because the cost of producing electric light is greater than that of producing gas. Why should not we allow the users of electric light to pay for the wire, and thus be more nearly on even terms of competition with the gas company? Of course I am in favor of free wiring where the electric light is first started, as an advertisement, but after that everyone should pay for his own wire, especially when you supply it by meter. I will give you an instance which has occurred more than once in our town, with cleat wiring. They will start in and paper their stores, and the paper hangers and painters will take down all your wires and cleats, and, about five o'clock in the evening you will get a telephone message to go down at once and fix up those wires. Now, if they paid for those wires, and had an interest in them, they would see that they were kept in proper order, and would think twice before they destroyed the work. But where it has cost them nothing, they look to you to replace it—they come to the conclusion, naturally enough, that having put it in for nothing, you will keep it up. There is another feature about free wiring—if you do it free, they think that every change that is made should be free also. In many cases it is mere foolishness and absurdity; they will change it to another place, and then, in a very short time, want it back in the first place again. I really am surprised at Mr. Thomson taking the position of being afraid to compete with a gas company. If they can afford to stand on their own bottom, and insist upon their customers putting in the necessary appliances on their own property, I do not see why any electric light man should not do the same.

Mr. Thomson: Allow me to say that our contracts call on the customer to pay for any changes that are made, or alterations. If our customers allow paper hangers to take down the wires, we see that they pay pretty good prices for putting them up again, and our contract also provides that they shall take just as much care of our property as they would of their own. We have frequently had it occur, that paper hangers have come in, and have left cleats down, but if they notify us at five o'clock in the evening that they want the light for that night they don't generally get it, but we let them wait till the next morning, and they learn a lesson they are not soon apt to forget.

The President: Electric light is a little more expensive than gas, and we have to throw this free wiring in as a sort of chromo.

Mr. Yule: I think Mr. Campbell is right, when he says that should be applied to working expenses, and the light made cheaper.

Mr. Thomson: I do not see how you can charge wiring to working expenses, it is a part of your plant, and cleat wiring, if a customer uses it for a year or two, and then decides to take it out, can generally be used again, and all you lose is the labor—the cost of the man's time putting it up and taking it down again. We have several times removed wires from places in Hamilton, and we invariably use that wire over again, unless it is "undertaker's wire."

Mr. Yule: What proportion does the cost of wire bear?

Mr. Thomson: It does not cost us more than seventy-five cents per light, cleat wiring.

Mr. Yule: Where we have put in cleat wiring, we find that the rosettes and other plant are virtually out of the market; you can't put the same stuff in another place, the improvements in appliances are too rapid to admit of it. Where they have been in, say for a couple of years, they are useless for a new installation.

Mr. Thomson: Very true; a couple of years ago they did not require that every light should have a fuse on it, but now it is a well known fact. Now, you can take them down from one place, and put them up in a dozen others. Of course the old wooden rosettes we used a few years ago, when taken down are no good, but that is the only case; there has been a change in underwriter's lines in that respect—an admirable change, no doubt, which should have been made years ago.

Mr. Fisk: I think the work you have in making use of second hand wire is as much as it is worth. According to my experience anything in the shape of sockets or electric light plant of that kind that has been made use of for any length of time, is worth as much to clean up as to buy over again. We did free wiring down at Peterboro' in the stores on a contract for one year. All changes and renewals, and everything of that kind, is charged to the customer.

Mr. Thomson: Of course you cannot do free wiring in houses, that is out of the question, because there your revenue is from only one or two lights out of every ten; the revenue would be so small in proportion to the investment that it is out of the question, though I know it has been done in my city in the first start out. But that is more to boom things than anything else; the old concern wanted to sell out to a New York syndicate, and to get themselves in a position for that, they wanted to wire for two thousand lights, and they went into a house, and wired it from the cellar to the garret, but in many cases we have taken the wires out. Now, speaking of sockets, we find in Hamilton that we can take old sockets and send them to the buffers and have them rebuffed and relacquered at three cents apiece, and other brass work the same way; it does not cost much to renew them. Speaking of fixtures, we always charge for fixtures; our free wiring simply includes plain cleat wiring run across the ceiling. Latterly, since we are pretty well filled up, we charge the labor at cost in putting in wires; it is only free to a certain extent; we charge from 75 cents to $1 per light for putting them in.

Mr. A. A. Wright: I suppose circumstances alter cases; where there is opposition, a man has sometimes to do what he would not do otherwise. But where you have the field to yourself, it seems to me it would be utterly foolish to do free wiring, because if you once start you must keep it up. I believe in the old saying, "Bring up a child in the way he should go," (laughter.) I think that applies to wiring as well as anything else; if you start right, I do not think you will have very much trouble. If we could get along without doing free wiring it would be a long step towards declaring a dividend at the end of the year.

Mr. Wickens: It seems to me that it is not necessary now to do free wiring to boom business. Perhaps when the business was a little younger it was necessary to coax people along, and it is all right to do a little free wiring for advertisement, but since it has become an established fact, and people know of it thoroughly, it seems to me to be an expense that should not be borne by the companies. The practice would naturally have the effect of inducing companies to do the wiring as cheaply as possible, because it may not be long before these men would take a notion to change, and the result of that is that the wiring is not done as well as it ought to be, and for that reason it leaks, and calls for more current than is really necessary to supply the light, whereas, if a customer does his own wiring he will possibly have it done well, and expect it to remain there as a fixture, and in all probability will take better care of it. I think it could be managed if the companies would stand up together, and say, "Now, we won't do this; we are supplying a light that costs considerably more than gas to manufacture, and the gas companies will not go into your house and pipe it for you." I think when you have delivered the current into a man's house, ready for him to hitch on to, that that is as far as the electric light companies ought to go, and after that the customer should be at the required expense; it would be better both for the consumer and the company.

Mr. Thomson: No doubt circumstances alter cases. Take large cities, like Toronto and Montreal, and I think probably they can get paid for their wiring. But even in Montreal, I know for a fact, that the Royal Electric Company there started doing incandescent wiring three or four years ago, and did free wiring. When I left there, a year and a half ago, we had some 5000 lights wired for. Now, we could not have got paid for those lights under any circumstances. Just about the time I was leaving we had decided to charge for the wiring. There is another little company there that has been bothering them considerably, as fleas do dogs (laughter). That company did free wiring, and the Royal Electric turned round and did it too, and the consequence was that in a year and a half they had 20,000 lights, where if they had not done free wiring they would not have had 2,000

Mr. A. A. Wright: What about a dividend?

Mr. Thomson: The Royal Electric is paying eight per cent. right along.

Mr. Wright: They get a good deal of this from their arc circuit.

Mr. Thomson: Very true. Take Hamilton, last year, 4 per cent.; we didn't get that from our arc circuit.

Mr. Starr: The practice in Montreal at present is to pay for all wiring, sockets and everything, and after that the company replaces and furnishes the lamps free.

Mr. Yule: I think, now this thing has been discussed, that there is practically no difference of opinion as to the advisability, or otherwise, of free wiring. The only regret I have is, that it should go out that Mr. Thomson is afraid to compete with a gas company. (Laughter.) I think the electric light is more æsthetic and more healthful and should be able to compete with gas. There is no manner of doubt that gas is not as good a light for a private residence as the incandescent electric is, and, taking these facts into consideration, I think the competition should be on pretty even terms between them, if each stands on its own merits, without any chromos or free wires.

Mr. Thomson: There is no doubt the incandescent light is superior to gas, as far as illuminating properties and health is concerned, but I question whether a man cannot put in eight or ten gas lights cheaper than he can eight or ten incandescent lights; I question whether he cannot run them cheaper—not, understand me, that he is getting the same amount of light with the eight or ten gas lights of so-called 16-candle power that he would with the same number of incandescent lights of 16-candle power. At the end of six months the gas jets begin to choke up, and they are not 16-candle power by any means. Now, many small storekeepers object to paying a dollar a month more than they would for gas. I have known them to take out the incandescent, because it costs a dollar month more, not but what they were getting more light for their money. But the gas jet was good enough for them before, and rather than pay the extra dollar, they will keep on using it, and that is the way the matter stands in my estimation.

Capt. Carter: As has already been remarked, "circumstances alter cases." I have had some little experience in this line in the last few years in regard to free wiring. We started a plant in Niagara Falls three and a half years ago, and after we had established our arc circuit we started out to find what prices we could get for incandescent lights, to see if we could get enough customers to induce us to go into incandescent lighting. We started out with a proposition to charge $2.50 per light for the installation. Now, as you are aware, Niagara Falls is a small place, and the storekeepers are poor, in comparison with those in large cities like Hamilton and Toronto, and we found it a very difficult matter to induce people to put the light in at all. I came to the directors and said, "We will have to do free wiring, for a time at least." They decided to do free wiring, and we did do it, and by means of that free wiring we wired up 700 lights. We have now got to that position that we have sufficient light to make it pay, and we are at present charging a dollar a light for installation, and $2 for concealed wires, so now we will get something for our wires. But I believe if we had charged from the first two or three dollars for installation we would not have had anything like the number of customers we have to-day.

and consequently our plant would not have paid, as it did, 12 per cent. interest. I think it was policy to do the installation to get the thing started in so small a place. That is the experience of a very small town and it has been remarkable, and although I very much favor the electric light company being paid for its wires, there are times, as Mr. Thomson has shown, where, as a matter of business, it is necessary to do free wiring. I think we must be governed by the circumstances in these cases.

Mr. Thomson : Captain Carter is no doubt right there. I think if his Board of Directors had decided to put in another big machine, they would go ahead and put in free wiring, and fill up that machine. If you are not getting revenue enough, and think you can do it by putting in more dynamos, the quicker you can fill them up, the more the machine will be producing a revenue, and I insist you must do free wiring in the small cities.

Mr. Carter : We are in that position at the present moment. We have, by means of free wiring, got our present system taken up, and our dynamos loaded. So now, we are obliged to extend our system, and just this last week, in a number of instances, I have to admit I have had to act like a Jew, aad make the best bargain I could, and if I could not get what I wanted, go without. There are a number of special cases, where, even this last week, in order to make contracts so as to get our new plant going, and sufficient lights taken up, we had to do it.

Mr. Thomson : There cannot be a particle of doubt that if you can get paid for it you should do so, but if you can't, you can't.

The President : Don't you think there is considerable objection on the part of new comers to paying for their wiring, when the others did not?

Mr. Carter : Yes ; we find that very hard, but we have to get over it the best way we can. We explain to the customer that when first starting business we found it necessary to offer an inducement to persons to put in the light. Now we have our business established, we charge one dollar towards the cost, which averages about $3 per light ; supplying the material all through we find that to be the cost, and we only charge one dollar, and we put it in that position to the customer, which is generally satisfactory.

Mr. A. A. Wright : I do not wish to speak too often, but if you put in a thousand lights, there is $2,000 added to your capital account. You may have competition to-morrow you did not think of, and there is that capital account pressing you. The way to make money is to keep down capital account. Now, let me give you one instance. At Arnprior they put in a thousand light machine ; they started last fall, and they have more lights ordered now than they can wire for and put in by next spring. So there is no necessity, under such circumstances, to do free wiring. I am fully of the opinion that you can get all the lights you want by exerting yourself, without doing free wiring. Of course, in a place like Hamilton you have to do the best you can.

Mr. Thomson : Arnprior has not a live gas company?

Mr. Wright : That is a question.

Capt. Carter : Only the other day, I had a gentleman from Hamilton who came down to the Falls, who wanted about eight lights put in a store. I told him our terms were eight dollars for the installation. He said, "Why, in Hamilton they wire free." We had quite a little hitch as to whether he should pay a dollar a light, but, after all, he wanted the light and he had to pay it.

Mr. Thomson : We are doing the same thing now. We are not doing absolutely free wiring, but charge from 75 cents to a dollar a light, but we had to do free wiring, especially after we got in a 1500 light machine, and wanted to fill her up, so she would not sit there and eat her head off.

A vote of thanks to Mr. Campbell for his paper was moved, seconded and carried.

The President then called upon Mr. R. G. Black, of Hamilton, who read the following paper :

THE INCANDESCENT LAMP.

Admirable as is the system of arc lighting for use in streets or large halls, it is entirely unfit to take the place of the numerous lights of moderate intensity employed for general domestic illumination. For this purpose it was at a very early period perceived that the incandescent, or heating to luminosity of a continuous conductor by an electric current, was the most promising method. It was also at an early period perceived that the conductor to be used for this purpose must be one which would admit of being raised to a very high temperature without being melted or otherwise destroyed.

The first material which was thought of in this connection was platinum, or one of its allied metals, such as iridium, which have the highest melting point among such bodies, and are besides entirely unacted upon by the air at all temperatures. In 1848 W. E. Staite took out a patent for making electric lamps of iridium, or iridium alloys, shaped into an arch or horseshoe form.

One of the most serious difficulties, however, even with these materials, was that, to secure from them an efficient light, it was necessary to bring them so near to their fusing points, that a very minute increase in the current would carry the temperature beyond this, and destroy the lamp by fusing the conductor. An escape from the difficulty was offered by the use of hard carbon, such as used in arc lamps, but here the compensating drawback was encountered, that this substance, when highly heated, was attacked by the oxygen of the air, or in other words, would burn. To meet this plans were devised for the replacement of the consumed carbon conductor and for its protection from the air by enclosing it in a non-active gas, or a vacuum.

Thus in 1845 a patent was taken out by Mr. J. W. Star, of Cincinnatti, for an incandescent lamp, the important parts of which are a platinum wire sealed through the top of a small glass chamber constituting the upper end of a barometer tube. This platinum was clamped to a thin rod of carbon supported by a non-conductor and connected by a wire to the mercury below. By passing the current through the platinum wire and thence through the carbon to the mercury the carbon strip, or rod, would be made incandescent and was to a certain extent protected by the surrounding vacuum. Though this lamp produced a brilliant light, it proved in various respects unsatisfactory and was abandoned after many trials.

Other inventors, as for example Konn, of St. Petersburg, continued to work with rods or pencils of hard carbon and achieved a limited success, but the irregularities and brittleness of the material seemed to have been an insuperable objection and drawback, and the problem of commercial electric lighting by incandescent conductors yet remained without a solution.

This was the state of affairs even up to the fall of 1878, when, as it is claimed, Mr. William E. Sawyer, in combination with Mr. Albion Mann, after many preliminary experiments, produced a successful incandescent lamp with an arch-shaped conductor made of carbonized paper. The lamp brought out by these gentlemen, after filing their application for a patent, on January 8, 1880, described and shown in that application, was a rather large and complicated structure, and had no improvements or simplifications of this lamp been made the present immense development in electric lighting would no doubt have been unattained.

It is to Mr. Thomas A. Edison, without doubt, that we owe many of the simplifications and modifications which, by cheapening the lamp and diminishing its weight, have extended its range of use and its usefulness to a remarkable degree. Like many before him, he first turned his attention to platinum and platinum alloys, and devised a form of lamp admirable for its simplicity, but unfortunately open to many fatal objections. During the year 1878, however, Mr. Edison was most diligently at work, and perceiving the imperfections of his first idea sought in every way to overcome them. Having experienced insupreable difficulties present in metallic conductors, he turned his attention to carbon in its various forms, finding fibrous textile material when carbonized to be the most convenient. Though working with the same material and form, Edison produced a structure very different in appearance from that of Sawyer and Mann, but bearing a marked resemblance to the lamps of recent manufacture.

The incandescent lamp of to-day is made in two parts, the outer flask, or the bulb, and the inside part. The first operation on the bulb is to punch a small hole in the center of the closed end of the flask where the exhausting tube is attached. Then the neck is cut off, making the flask the proper length for the carbon. While the bulb is being thus prepared, the inside part, which supports the carbon, is being made. This is done by taking a piece of glass tube about six inches long, and holding it in a glass blower's fire until one end becomes white hot, then two copper wires ingeniously welded to short pieces of platinum wire are run up through the tube until the platinum extends about a quarter of an inch above the hot end of the tube ; then the tube is again heated until the platinum and the glass come to a white heat. The end of the tube is then squeezed flat, the platinum being hermetically sealed in the glass. Platinum wire has to be used, as it is the only conductor that has the same coefficient of expansion as glass; these, after being annealed, are ready to have the carbon clamped on. This used to be done by welding a small copper clamp to the end of the platinum, then squeezing the clamp on the carbon, the clamp and the carbon being then copper plated, making an excellent joint. This is done by a simpler process now, however. When the carbon has been securely fastened to the platinum, the inside part is ready to be sealed into the bulb.

Until recently the bulb was sealed over the inside part by hand, but within the last few years a machine has been devised to do this otherwise skilful and difficult manipulation. The bulb and inside tube are turned in the fire until they are securely sealed together. The lamps are then annealed, and after the projecting piece of the inside tube which has served as a handle, has been cut off, the lamps are ready for the vacuum pumps. The next thing to be done with the lamps is to exhaust them. For this purpose they are attached by the small glass tubes before mentioned to the phosphorous cups, and those in turn are attached to the pumps and the mercury turned on. The mercury is allowed to run until a good vaccum has been secured, then the current is turned on and the carbon filaments heated to a dull red, being gradually increased until about half the rated candle power of the lamp is reached. Then each lamp has to be treated individually, in order to work out any gases or impurities in the carbon. This is done by placing a strong magnet at the lower end of the carbon to prevent it from wilting while the current is suddenly increased and the light raised to great brilliancy for a second or two. This is repeated several times, until the mercury tube shows that the gases have been dissipated by the extremely high temperature of the filament. The eliminating of the gases is considered the last of the many stages through which the carbons of our incandescent lamps pass. It is only necessary to seal off the connecting tube which leaves a small top on the lamp where the hole has been closed up. The lamps are then socketed and tested for the volts required to give a certain predetermined candle power. The voltage is marked on the bottom of the lamp and then it is ready for shipment.

Some of you will ask no doubt, is there is not danger of destroying the filament while driving out the gases? Well, there is, if great care is not exercised. The test is a severe one and only good filaments will stand it. However, it seems a necessary evil. The carbon filament is the all essential part of the incandescent lamp ; so important is it that the manufacturers have tried almost every conceivable substance, calling on the productions of the mineral, the animal and the vegetable kingdoms.

Although many good hair filaments are made, vegetable fiber seems to be the most preferable substance for carbonization. This process, although most sacredly guarded by the different manufacturers and varying vastly in detail, is in general as follows : The substance to be carbonized, whether paper, cotton or bamboo, is cut by a machine into delicate strips which are collected in small bundles and bent so as to lie in "U" shaped grooves in graphite plates. These packed with graphite powder, are placed in large black lead crucibles, carefully closed and heated in a Siemens furnace to an intense white heat. After cooling the crucibles are opened and the now carbonized filaments looking like delicate wires, or threads of steel, are removed. They are now the curved shape into which they were bent before carbonization, but are quite elastic and strong. There are various after treatments, such as subjecting the carbons to a plating process, or treating in a vacuum with hydrocarbon, etc. But as said before, the different processes to which these filaments are subjected, are trade secrets. In them lie the important distinction of life and economy given by lamps of different manufacturers.

The distinctive features of the different types of incandescent lamps which are in practical use now, are naturally indefinitely less striking than those in the arc lamp. The latter employs a more or less complicated regulating mechanism, and the constructive detail of this mechanism give rise to an enormous variety of lamps. The incandescent lamp which is fortunately restricted to the use of an incandescent filament, placed in an exhausted globe which does not require any regulating mechanism, allows of a difference only :

1—In the choice of the raw material from which carbon filaments are made.

2—In the treatment of the raw material before and after carbonization.

3—In the length of the filament and its cross section.

4—In the mode of connecting the filament with the current conductor, or platinum wires respectively, which join it to the leads.

5—In the more or less perfect exhaustion of the lamp bulb. In considering these different points, we wish to arrive at a conclusion, not that one particular type of existing lamp is superior to another, but what are the conditions to be filled in order to obtain an efficient incandescent lamp of good durability.

All incandescent lamps with the exception of the Cruto and Bernstein lamps, employ a vegetable fibre of some kind as raw material for preparing the filament. Edison considers the fibrous structure of bamboo advantageous for obtaining a tough filament of high mechanical resistance ; while Weston on the other hand subjects the cotton fibre to a process which entirely deprives it of its structural character and transforms it into amorphous cellulose, for which he likewise claims great toughness and mechanical resistance. We know that excellent results have been obtained with both these filaments, from which we may safely draw the conclusion that the nature of the raw material is of little consequence as long as it is of a thoroughly homogeneous character. The carbon is exposed to a series of deleterious influences, which are the more effective the less coherent the filament, not to mention the shocks and concussions to which the lamps are subjected in transportation. We find that, according to the mechanical theory of gases, the last remnants of atmospheric air, which are, even in the most careful exhaustion, left in the lamp bulbs, are set into rapid motion by the intense heat of the carbon ; and thus the latter is exposed, so to say, to a continuous bombardment, which soon finds out any weak spots in its texture and brings about a rupture of the filament. There are other influences at work tending to produce the same result, namely: the disintegrating effect of the current and the high temperature to which the filament is raised, and which show themselves in the projection of carbon particles on the interior of the lamp bulb (commonly called the blackening of the lamp bulb).

Under this head, we have also to consider a fact observed by Edison, namely: A continuous current passing through the carbon wastes it more rapidly on one side than on the other. For explanation of this fact, we must assume a sort of electrolytic process in a space which is not absolutely free from air, but only highly attenuated. If this observation is correct, and we have no reason for doubting its accuracy, it constitutes an additional reason for the importance of the uniformity of the filament. We have further to take into consideration the influence of the electric current on the structure of the carbon filament ; and that such an influence is exercised has been proved by the molecular changes of a copper wire through which the currents of an alternating machine have been passed for some time. Finally, the higher the temperature to which the carbon is exposed the shorter its durability, and the more marked the deleterious effects on a filament of inferior compactness and uniformity. Hence the condition of radiating surface is one of the main factors in the economy of the glow lamp, and the whole treatment subsequent to carbonation has for its aim to endow that surface with the highest possible radiating capacity.

Until quite recently it has been the object of lamp dealers to procure long-lived lamps, thereby reducing the expense of renewals, hence being better able to compete with other illuminating agents. In order to procure this durable lamp the filament was made much stouter and in consequence lower in resistance. It was found that although these lamps lasted for several thousand hours, they require considerable current, therefore were not very economical. The aim of lamp manufacturers now became to obtain the greatest number of lamps per horse-power, that is to get the greatest amount of light for the least expenditure of energy. To do this the filaments were made longer and finer, and by the after process of carbonization, the resistance was considerably raised. For these and numerous other causes, the different types of lamps range in efficiency from two and even as low as one and a half, to six watts per illuminating candle-power, or in other words one lamp will give three times as much light as the other for the same expenditure of current. If this was all the data to be obtained, the problem of determining the best lamps to be used would be a simple one. But it is a well-established fact that an incandescent lamp maintained at a constant voltage will invariably fall off in candle-power. This diminution in brightness is attended by an increase in the amount of energy consumed per candle-power of light, the change being especially marked in the earlier portion of the life of the lamp. This phenomenon appears to take place in all incandescent lamps of the present day, and more particularly in lamps of high economy.

These changes may be ascribed to at least three causes, viz.: loss of vacuum ; increase of resistance, due to the disintegration of the filament; and finally the deposition of the disintegrated carbon upon the inner surface of the lamp bulb.

Recent elaborate tests go to show that although a lamp may commence with a very high efficiency, say at two watts per candle-power of light, during the first two hundred hours the lamp is likely to decrease uniformly to seven or eight candle-power, thereby only having an efficiency of five or six watts per luminating candle-power. After this point, the falling-off in candle-power and efficiency is not so marked, but continues until the carbon is at last consumed. This falling off in candle power is decidedly unfair to the consumer, who is charged for the full rated candle of the lamp. Nor is it economical to the illuminating company, who are consuming as much, if not more current than when the lamp was burning to its full brilliancy.

Taking all facts into consideration it would seem, according to our judgment, that the best lamp to procure for station work is one of moderately high economy, say of about 3.1 or 3.2 watts per candle-power of light. Having selected our lamp, it now remains for us to decide upon the most successful way of operating and taking care of them.

It is a well-known fact that the efficiency of an incandescent lamp increases very appreciably the more it is forced, that is, the number of watts required per candle-power of light becomes less the greater the voltage to which it is subjected. It is also well known that on the other hand the life diminishes very rapidly the more a lamp is thus forced. As the total cost of the light is increased by going to either of these extremes, of long life and poor efficiency on the one hand, and good efficiency with short life on the other, there must be some intermediate value for the life and the efficiency which would give the most economical results, considering both the cost of the lamp and the power required. Numerous different methods have from time to time been suggested and used to determine this point with more or less success. But they have all apparently led one to believe that a long life is a most desirable feature, so much so, that extremely long lived lamps were considered as great achievements in lamp making. More recently the tendency has been to increase the efficiency slightly and to diminish the life. But it appears now from the very interesting deductions of Mr. O'Keenan that the most economical point, considering all the factors involved, is very materially different. from what was generally supposed, and that it is in fact cheaper to replace old lamps with new ones after a few hundred hours, rather than to continue to burn the old ones. He shows that there is a point in the life of each make of lamps at which it will pay best to break the lamps. To this point he gives the appropriate name of "the smashing point."

Whether you accept these statements or not, lamp renewals is an important item in the expenses of an illuminating station and amounts to considerable, even in small isolated plants. It is therefore a question of momentous importance to be able to decide what kind of lamps are best to use and what is the best way to manage them, so as to secure the most satisfactory results not only in regard to the financial interests of the illuminating company, but also that the public may get the best value for their money.

Having decided upon the best lamp to use, after giving due consideration to the various data supplied by different manufacturers, all of which should be received with the greatest of caution, the next thing to obtain is an absolutely steady current. A precisely even potential is one of the most essential requisites for obtaining any sort of satisfactory results with incandescent lamps. It is astonishing how little attention is paid to this important feature of incandescent lighting. Tests which we have made convince us that there are few stations in Canada which can boast of a potential which does not vary from five to fifteen volts either side of what it is supposed to be operated at. A raise of three volts in a hundred volt lamp will reduce the life one-half. This change is much more marked in lamps of lower voltages. It is a wonder that lamps last half as long as they do, subjected as most of them are to such a range of potential varying in many cases from one hundred to one hundred and twenty volts. We would most emphatically recommend that a man be detailed in every large plant or station to watch the pressure indicators and regulate the current accordingly. Also that the station be provided with a good portable volt meter. so that the potential may be known at different points. If these regulations are strictly and promptly carried out, there would be far fewer complaints about incandescent lamps.

This branch of the electric industry is launching out into new channels, and even now plays an important part in the service of man, not only in domestic spheres but also in the scientific and other useful pursuits of life. Lamps can be had from a fraction up to several hundred candle-power, varying in size, shape, color and efficiency. Now that we have the Ries regulating socket by which the light can be turned up or down without waste of current, the incandescent light is in every way superior and has every advantage offered by any other illuminating agent without their disadvantages, defects, and impurities. May we not therefore conclude with all justice and honesty that the incandescent lamp is destined to be the light of the future?

DISCUSSION.

The President : As a matter of history, I do not know whether it is universally, or even well-known, that Toronto is about one of the the first places where a practical incandescent lamp was constructed. Some years ago, I think at the time the original Gramme machine was made, there was one imported, and some incandescent lamps made here and operated on that machine. There was a patent taken out for these lamps at the time, which ante-dated all the present incandescent lamp patents on this side, even Edison's, but there was one little defect in it. In making out the specification for the patent, the gentleman who got up these lamps got on all right until he got his carbon filament complete and his vacuum. If some one had come along and hit him on the head with a club when he got that far, he would have been the inventor. But, unfortunately, after he got his globe empty he filled it again with something else, with some gas or hydro-carbon, of course making it entirely different from all the patents of the present day. I think that must have been some time in the year 1874.

Mr. Neilson : I happen to remember the date particularly, Mr. President, because I was a stockholder in the company in which Mr. Fuller made his experiments. We afterwards wound up with fifteen cents on the dollar, and that is, therefore, strongly impressed on my mind. (Laughter.)

The President : I think the members will find when they analyze this very clever paper, when it is put in print, that it is a most valuable addition to the literature of the science.

Mr. Neilson moved, seconded by Mr. Thomson, that the thanks of the Association be tendered Mr. Black for his very able and interesting paper. Carried.

AMENDMENTS TO CONSTITUTION AND BY-LAWS.

The President : I will now ask for expressions of opinion on the question I placed before you yesterday, as to the advisability of forming sub-sections of the Association, simply as a guide to any committee that may be appointed with a view to formulating changes of the constitution to be laid before the next Convention.

Mr. McFarlane : My own present view of the matter is, that I think the Association is too small yet to branch off in that direction, more especially as we seem, so far, to have got along very well without it. Were it necessary to branch off on any one subject, such, for instance, as the economy of fuel, a committee can be appointed on that, to report to the Association, and those who do not wish to speak on it will be very glad to listen to what is said.

The President : The idea does not seem to obtain an overwhelming number of supporters, so I presume it is just as well to let it slide. A question that must be discussed, however, is the time and place of the next meeting of the Association.

Mr. Taylor : In regard to subdividing, it seems to me that if a question came up at a general meeting which directly applied to central station work, it should be voted upon only by central station men. It struck me that the proposed plan was a good one, and I do not see that it would interfere with the general working of the Association at all.

The President : I hope there is no misconception as to the idea. One or two seem to have the idea that we are proposing to subdivide the Association ; that is not the idea, we have got along so harmoniously together that that is the last thing I would like to see done. The proposal is simply to appoint committees, or subdivisions, on each question particularly appertaining to any one branch alone, very much, as I said yesterday, in the manner that is done by the Toronto Board of Trade. It is divided into sections, merely in the shape of committees, to which are referred any particular business that concerns that section alone. But perhaps all that would be necessary would be to have it understood that subjects of that character would be simply referred to committees from the branch interested; we might have committees definitely appointed, representing each branch of the Association, or, if it is thought well, the matter can be left just as it is.

Mr. Yule: I agree with Mr. McFarlane, that we have not yet reached the point where we can divide. We are getting along very nicely, and I think, in the meantime, we had better leave things as they are; we want to be a little stronger in numbers first.

Capt. Carter: I think the subject is not given the attention of which it is deserving. I think there are members here, like myself, who are a little afraid to speak; they can talk among themselves, and interest themselves in it, but they don't like to get up here and ventilate their views. I feel that it is a very important question, although I would not for one moment put it in such a way that the interests of the electric light people, the telephone people and the telegraph people should be severed at all; we ought all to remain as one Association, as we are at present, and sit here and listen to each other's views. I like to sit here and listen to the papers upon telegraphing or telephoning—I have great pleasure in listening to them—but still, as has been suggested, there may be subjects that are of direct interest to electric light men, telegraph men or telephone men, but would not be of interest enough to other members of the Association engaged differently. I do not think it would at all interfere with the harmonious working of the Association as a whole, if in cases of that kind we had committees which could be called together for an hour during the meeting, to discuss among themselves any particular question solely affecting their own particular interest, and in which other branches are not at all interested. I think it is well to have this subject thoroughly well ventilated, because I know there are those to whom I have spoken privately who do not feel like getting up and speaking on the subject.

Mr. Fisk: I am interested in this. I think the central station men are more competent to deal with a question relating to central station business than the Association as a whole is. I think it would be a good thing to have each member registered in some particular section, and have questions affecting that particular section referred to them. I, for one, would like to see that.

Mr. Armstrong: We have all heard the saying, "First catch your hare, then cook it." It seems to me, in this instance, we have first to catch our central station men, of whom we have not enough; the objects of this Association are undoubtedly more in their interests than in those of the manufacturing and supply companies, and, in order to get the Association spread generally through the country, it would be wiser not to weaken it by separation at present. We must use every means, including the assistance of telephone and telegraph men, to spread a knowledge of its objects through the country, and if we start to divide now, it will certainly defeat the objects which the Association has in view. We must hang together for strength like a bundle of sticks.

Mr. Breithaupt: Central station interests are a separate interest, whereas the telephone and telegraph interests are matters representing the whole Association. I agree with Mr. Armstrong, but I think the idea of appointing a committee on central station work, in their interest, would be advisable.

Mr. Neilson: At the first meeting of the Association, I foresaw this difficulty would arise. As long as we are an Association of electricians, meeting to exchange views on electric subjects only, there is not the slightest necessity for any subdivision of any kind. But when you introduce what I might term financial aspects of affairs, then it might be well to have these sections. But then the difficulty comes in, that a section, such as the electric light section, might bring in a recommendation such, for instance, as was moved at the last meeting, of standardizing the current for a lamp; well, now, that should, if the sections are to be formed, be the opinion of that section, and not of the Association as a whole. If that is done, I see no objection whatever to having an Electric Light and Power Section. But the other departments can get along without anything of the kind. I would strongly object to having any resolution of this section brought in as the opinion of the members as a whole on any particular subject.

Mr. G. Black: I think where a question arises on a subject relating purely to the telephone, the telegraph or the electric light section, requiring a decision, that only members of that section should decide upon that question. It was pointed out in the course of discussion at Hamilton, that telephone men would not probably like the electric light men to decide upon their system of wiring. A telephone man, while competent enough to do his own wiring might not understand sufficiently well how to do electric light wiring. Where the subject is purely sectional, it should be voted on only by members of that section of the Association. We have now an Executive, composed of representatives from all branches, and if they cannot decide upon a subject, then let the members of that department only decide, while in general subjects the decision should be that of the whole Association.

Mr. A. A. Wright: As a central station man, I do not fear my friends of the telegraph and telephone fraternity would do anything to interfere with us very seriously. It may be advisable, when the time comes, or when the difficulty arises, to have a committee appointed to look after central station work. But, "sufficient for the day is the evil thereof," (laughter), and I think it will be time enough to encounter the difficulty when it arises.

The President: The idea is not at all, as I have already said, to divide the Association. It would be just as Mr. Black says, that those who are particularly interested in a question not affecting the other members of the Association would be the only ones to vote on that question. Let members register in any section they choose, in which they are doing business. Then, when a purely sectional question comes up they vote on it. I do not think anyone proposes that this Association be divided up, and one part to meet at one time, and another at some other time—no one entertains any such idea as that. I think it is simply in order to simplify matters, that in certain questions affecting only a certain branch of the members of the Association that only those who are interested in such questions shall vote upon them. In any matter of business policy, for instance, which concerned some one section alone, it would hardly be fair to the members of that section, if members from other sections should, by their preponderating votes, defeat the objects of those belonging to that branch. As we can bring in no resolution now, this is simply a sort of ventilation of the idea, to get it into shape in case any action should be found necessary at the proper time, and it can easily now be postponed until that time, or until the Executive sees fit to bring in a recommendation, or a committee is appointed on the original constitution.

Mr. Wickens: I think this Association does not at present need anything of that kind. If any trouble should arise, it might be well to appoint a committee of the members specially interested to deal with that particular question. Now, if you go on and appoint, say a standing committee in each branch, as it were, it will have an effect which I think is hardly desirable, because that standing committee could not do anything without meeting. That would be well enough in the case of a body like the Toronto Board of Trade, the majority of the members of which reside in Toronto, and which can get a sectional meeting at any time without difficulty. But our members are scattered all over the country, and if we attempt to create standing committees in each section of the work in the way spoken of, they will really not be of any practical use, unless they can come together, and it is hardly to be expected that they will meet together as sectional committees, and then come to the Convention also—it would take too much time—and it will certainly, to my mind, detract from the interest of the Convention if anything of that kind is countenanced. I think if there is any real difficulty in any branch, that wants settling, it will be soon enough when it appears to appoint a committee.

Mr. Fisk: I feel somewhat strong upon this question. Suppose the question came up whether it was better to use one hundred volts or five hundred volts power in transmission, would it not be better to refer that to a committee composed entirely of central station men?

Mr. Campbell: I do not think there is any necessity at the present time at all. Regarding the question our friend has just spoken of it makes a big difference, as far as induction is concerned, whether you jump across a telegraph wire with one hundred or five hundred volts. I think it is better to let the Association stay as it is now.

Mr. McFarlane: You have spoken of the electric light, the telephone and the telegraph men, but you have left out the supply men. I suppose when you want to discuss wire it would be better to appoint a committee on wire, and if dynamos, appoint a committee on dynamos, to tell the electric light men what to get. (Laughter.)

Mr. Taylor: Mr. McFarlane was wrong in saying the electric supply men were not heard from, but I did not speak because of anything I expect to get in the way of supplies, it was because of the difficulty which I saw arose at our general meetings. I do not suppose the supply men would have anything to come before them unless it was what Mr. Sadler spoke about last night, the belt slipping. (Laughter.) I think where a question is brought up directly interesting central station men, it should only be voted upon by central station men.

Mr. McFarlane: I was not saying that the supply men had not been heard from, but I was speaking of them as one section of the members of which the Association is composed.

The President: I am very well satisfied from the expressions of opinion that have been elicited, that all are satisfied to "let well enough alone," and after what I have heard I am inclined to favor that view myself.

AFTERNOON SESSION.

At two o'clock the meeting having been called to order by the President, papers were respectively read by Mr. Rosebrugh, of the School of Science, on "Speed Control"; and by Mr. Breithaupt, of Berlin, on "Probabilities as to the Success of Distribution of Power at Considerable Distances by High Tension Currents of Electricity."

Lack of space has made it necessary to defer publication of these papers and the discussions thereon to a subsequent issue.

PLACE OF NEXT MEETING.

The President : The only business now remaining is to decide upon the time and place of the next meeting. Suggestions will now be in order.

The Secretary : I think the Industrial Exhibition Association expressed a wish that the next convention should be held in Toronto simultaneously with the Industrial Exhibition, and it was their desire that the Association should endeavor to hold some kind of an electrical exhibition in connection with the Industrial ; I think that is as far as the matter has gone.

Mr. Smith : At the last convention it was discussed, without anything being definitely settled. The wish was expressed by the Industrial Association that we should meet in Toronto, and have an electrical exhibition, and it was then thought we would be able to do it. Since then we have information which would rather discourage the idea. At the same time, without wishing to appear intensely selfish, for reasons pretty well known, I would move that the next convention be held in Toronto, during the month of September, at a date to be fixed by the Executive.

Mr. Thomson : I move, in amendment, that it be held in Montreal.

Mr. Carroll : I second the motion.

Mr. Starr : Mr. President, I would like to second the motion of Mr. Smith, that the next convention be held in Toronto. I think it was generally understood among the members that the next convention was to be held in Toronto, and that the Industrial Exhibition people would co-operate with us in making an exhibition here. As a representative of Montreal, I may say that we should be most happy to see the convention there, and, speaking for myself, I would do everything I possibly could, and I think my company would also do everything to make the visit to Montreal pleasant. We have a pretty good reputation now, through the National Electric Association, which visited us a year ago, but we have hardly got over that yet (laughter). We want about three or six months' grace after the next convention to get into a position to entertain the Canadian Association. We do not want to undertake it unless we can do it thoroughly. Perhaps Mr. Carroll can speak better on that subject than I can. We would prefer the next convention to be held in Montreal in the spring, or during the winter, say, a year from now. I therefore think I will support the next convention being held in Toronto, and the one after that in Montreal.

Mr. A. A. Wright : Might I be allowed one word, with reference to the time. Most of the central station men from the smaller towns, like myself, are engaged in some other business as well, and our trade being a rural one, there are certain seasons of the year when we are busy, and others when we are not. September is our busiest time, for the farmers are then through the harvest, and begin to market their grain, and tradesmen whose business is connected with farmers then have to be at home. If you held it in connection with the Exhibition in Toronto or Montreal, I suppose you cannot change the dates, but if it could conveniently be arranged early in the month of September, I think it would certainly be a great accommodation to those central station men who live in rural districts, and not make any difference to those in the city.

The President : The Industrial Exhibition is held very early in September, and I have no doubt it would be a factor in helping to make it a success.

Mr. Smith's motion was carried, that the next convention be held in Toronto, at a date to be appointed by the Executive Committee.

Mr. Starr : In explanation of my having seconded Mr. Smith's motion, I may say that we do not want to have the convention in Montreal until we are in a position to fittingly entertain the Association. As I said, we have not quite got over the last convention we had there.

Mr. Smith : Speaking for the Western members, we are anxious to give Montreal a turn, and when the convention goes there we want to make it one of the best we have ever had.

Mr. A. A. Wright : I would like to thank those who placed this institution at our disposal. I did not know that we had such a one here, or, from patriotic motives, I would not have sent my son to Montreal (laughter and cheers.) If there is an educational centre in Canada it is Toronto; it is the intellectual capital, and I want to uphold it. However, whom are we to thank ?

The Secretary : The Faculty of the School of Practical Science.

Mr. Wright : Then I have pleasure in moving that they receive our thanks for the use of this hall, and the courtesy they have shewn in attending our meetings here.

Mr. Starr seconded the motion and it was carried.

Prof. Galbraith : I am sure Mr. Wright's kind remarks are highly appreciated by the Faculty and myself ; and we shall have great pleasure in seeing you here at some future time. Of course you know, Mr. President, that this building is under the control of the Ontario Government, and whenever we want to have it in any way diverted from its ordinary use we have to apply to the government for permission. But I have never yet known that permission to be refused. The Minister of Education has always agreed with me in feeling that whatever this institution can do in connection with any of the professions with which our work is allied, will be done, not only in their interests, but in our own. I do not think you have much to thank us for. However, perhaps our friend will send his next boy here.

Capt. Carter : Would it not be proper on our part to tender our thanks to Hon. Mr. Harcourt, the acting Minister of Education, as well as to the Faculty.

The President : I think in expressing our obligation to the Faculty that is implied.

Prof. Galbraith : I would suggest that the two be coupled together ; I would prefer if any motion is made that the Minister of Education should be included.

The motion, amended by adding the Minister of Education, was carried.

The thanks of the Association were also tendered the press of Toronto, for the efficient manner in which they had reported the proceedings.

The convention then adjourned.

C. A. S. E. NO. 7 ORGANIZED AT OTTAWA.

OTTAWA, Jan. 30th, 1893.

Editor ELECTRICAL NEWS.

SIR,—The ranks of the C. A. S. E. were reinforced on Wednesday, Jan. 18th, by the organization of Ottawa No. 7 with a charter membership of 32. Mr. Edkins, President of the Executive, had for some time previous been in communication with Mr. F. Robert, engineer Russell House, with a view to establishing an association here. To the interest taken in the matter by this gentleman, who interviewed the engineers on the subject, and called a preparatory meeting to discuss the matter, the organization of a large and useful association in Ottawa is due. After an explanation by Bro. Edkins of the objects of the association, the following officers were initiated, elected and installed : President, J.A. Thompson ; Vice-president, J. B. Seguin ; Treasurer, J. Cowan ; Rec. Sec., J. Latour ; Financial Sec., F. Robert; Conductor, A. Gaul ; Doorkeeper, C. Schofield.

A committee was appointed to secure a suitable place of meeting.

Under the head of "Good of the Order" Bro. Edkins addressed the meeting.

A vote of thanks was tendered to him and also to Bro. F. Robert for the latter's persevering work in bringing the engineers of Ottawa together.

Ottawa No. 7 is composed of good practical men who recognize the need of organization and the good results which must accrue from it. The officers are of the right type and with J. H. Thompson, Chief Engineer Printing Bureau at the throttle, we look forward to a very successful year. The ELECTRICAL NEWS shall hear from us now and then.

OTTAWA NO. 7.

SPARKS.

A $25,000 electric plant has been purchased by the Town of Yarmouth, N. S.

A 200 light incandescent plant is being installed by Messrs. Wm. Kelley & Son, at Blythe, Ont.

A 20 horse power electric motor has been installed by Messrs. Parker & Co., coppersmiths, Toronto.

Elias Vernon and Benjamin Temple, of Hamilton, Ont., were recently granted a patent on a device for starting cars.

A 1,000 light dynamo and plant has recently been installed by the Moncton Gas and Electric Company, Moncton, N. B.

A 700 light dynamo is being installed by the Victoria Electric Company, at Lindsay, Ont., and a 200 light dynamo by the Brantford Electric Light Company.

Messrs. Patterson & Corbin, of St. Catharines, have a contract to supply 36 cars for the Niagara Falls Electric Railway, and 4 cars for the St. Catharines Electric Railway.

William Giles, a dynamo attendant in the Hamilton Electric Light and Power Company's power house, recently received a severe electric shock, which rendered him for a time unconscious.

During the first three months of the operation of the Yarmouth, N. S., Electric Street Railway, there were carried with only two cars running, 58,326 passengers. The cars are heated with electricity.

The Niagara Falls Electric Railway Co. will install six 250 horse power dynamos. The contract has been given to Messrs. Kennedy & Sons, of Owen Sound, for turbine wheels with which to operate these machines.

By authority of the shareholders, the capital stock of the Montreal Street Railway Co. will be increased to $2,000,000, to meet the expenditure required in connection with the equipment of the company and the conversion and extension of their lines.

Incorporation is being sought for by the Peoples' Electric Company at Windsor, Ont., with the object of operating electric railways, and supplying electricity for commercial purposes in Windsor and vicinity. The capital stock is to be $50,000.

The County Court at Windsor, recently awarded $50.00 damages to one Wilson, who brought suit against the Sandwich, Windsor and Amherstburg Railway for personal injury received as the result of an electric car coming into collision with his buggy.

Applications for incorporation has been made by the Compagnie Electrique, St. Jean Baptiste, Montreal, for the purpose of doing a general electrical business, supplying light, heat and motive power, and manufacturing electric appliances in the Province of Quebec; also for the construction of underground conduits for electrical wires in public streets and roads. The capital of the company is to be $100,000. The names of the directors are as follows:— Messrs. Onesime Marin, notary; Hon. Louis Tourville; Arthur Caron, gentleman; Raymond Prefontaine, Montreal, M. P.; Israel Charbonneau, manufacturer; Joseph E. Pare, manufacturer; Joseph Lalonde, manufacturer; and Damien Lalonde, manufacturer.

The Beacon Lamp Co., of Boston, are contesting the suit for the infringement of the Edison patent, brought against them by the General Electric Co., with the claim that Henry Gobel, a German-American, invented and used an incandescent lamp prior to Mr. Edison's invention, and that consequently the Edison patent is invalid.

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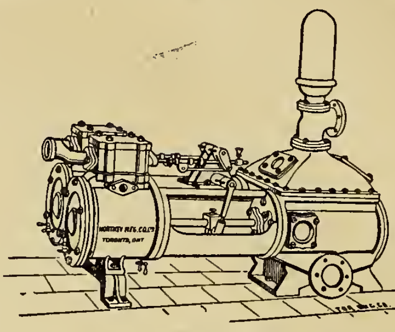

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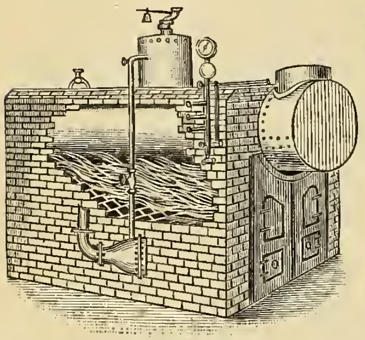

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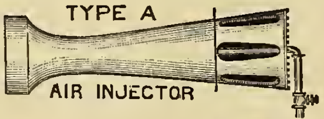

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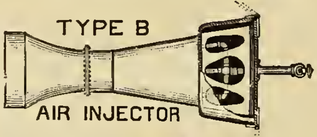

AIR INJECTOR

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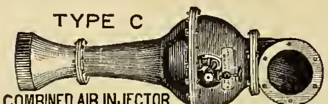

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SPARKS.

Mr. John Skinner, of Mitchell, will install an incandescent lighting plant.

The Review Printing and Publishing Co., of Peterboro', have installed electricity as their motive power.

A Victoria company has purchased Mr. A. Haslam's interest in the electric light works at Victoria, B. C.

The Carleton Place Electric Light Co. have purchased an incandescent plant, which will shortly go into operation.

A 300 light incandescent plant is being installed in the Leland House, Winnipeg, by the Kay Electric Works, Hamilton.

Messrs. Corley & Collins of Mount Forest, have purchased a new 60 horse power engine with which to operate their electric light plant.

The loss sustained by the Sandwich, Windsor and Amherstburg Electric Railway Company, by the burning of their power house, is placed at $15,000.

The recently incorporated Smiths Falls Electric Power Company will shortly erect new buildings, and a new flume, and will install a light and power plant.

The Chaudiere Electric Light and Power Company, of Ottawa, are desirous of enlarging their business, and for this purpose have applied for permission to increase their capital stock to $1,000,000.

Mr. Charles W. Harrah, representing a Detroit syndicate, has purchased for $15,000 the Windsor and Walkerville Railway. It is the intention of the present owners to equip the road for operation by electricity in the spring.

Mr. F. E. Handy, formerly with the Ball Electric Light Co., Toronto, and an Active member of the Canadian Electrical Association, has gone to British Columbia to assume the position of manager of the Westminster and Vancouver Tramway Co.

The stipendary magistrate of the city of Halifax, has convicted the Nova Scotia Power Co. of a breach of a provincial statute in running street cars on Sunday. The judge holds that the running of street cars on Sunday is a work of neither necessity nor mercy, and is therefore illegal. A nominal fine of $5.00 has been imposed on the company. The case has been appealed.

The Quebec and Levis Electric Light Company have purchased for $236,000 the Falls of Montmorency and the surrounding property belonging to the Hall estate. The company have under construction a new iron flume, 1200 feet long and 6 feet in diameter, by means of which the water will be conducted from above the cataract to the factories below. It is probable that the company will supply power for the factories in Quebec, light for private residences and city streets, and motive power for the street railway, and for trains on the Montmorency Railway. At the annual meeting of the company the following directors were elected: Andrew Thompson, Hon. E. J. Price, H. T. Machin, C. R. Whitehead, Herbert M. Price, John Sharples and T. H. Dunn.

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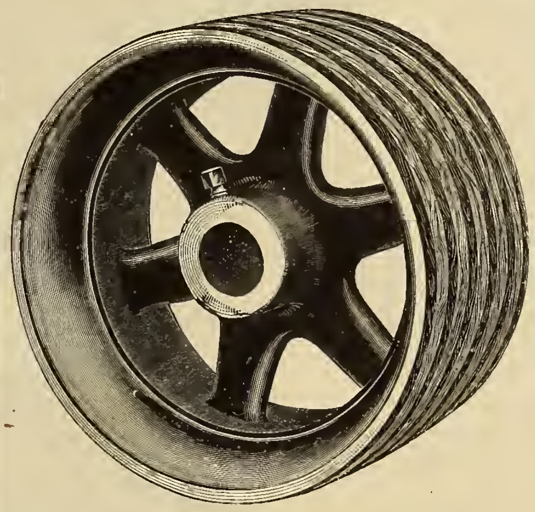

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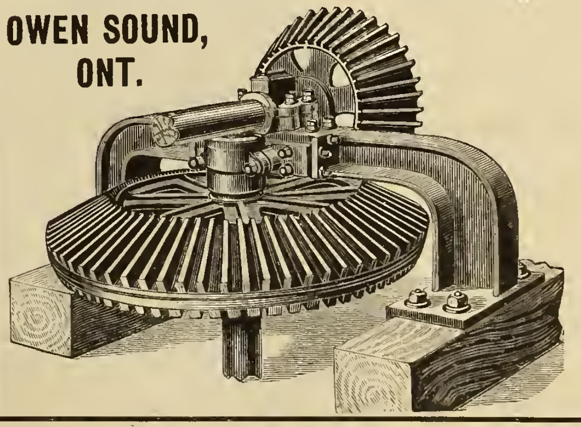

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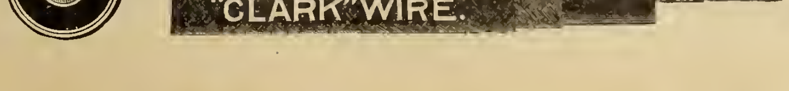

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NOTES.

Toronto *Globe*:—A man in Montreal has been fined for illegally practising dentistry, yet a stationary engineer on whose care and skill a score of lives are daily depending is not required to pass an examination.

The New York Equipment Co. have kindly sent us with their compliments, several vest memorandum tablets made of celluloid—a very useful article.

A new sort of condenser has come into use for steam-engines in France. Where steam-power is used on an extensive scale, it often becomes a matter of considerable importance to cool the water condensed from the steam as rapidly as possible. The more quickly the exaust steam can be condensed into water, the greater will be the difference of pressure between the two sides of the piston, and, consequently, the greater the power developed with a given consumption of coal. For cooling the condensed water, it has been common to run it through clusters of pipes, so as to expose as large a surface as possible to the air, or to allow it to drip through bundles of laths or brushwood into a tank. Under the new system, the condensed water from the exaust is pumped into a sort of gridiron of large pipes, which are pierced with a great number of small holes, but have no other outlet. The water forced into these pipes under a considerable pressure, spouts in innumerable tiny jets from the holes, and then falls into a tank beneath. Being brought in a state of fine division into direct contract with the air, it loses its heat very rapidly, and, on reaching the tank, is already cool enough to be pumped back for use in condensing the steam from the cylinders. Of course, the jets of hot-water give off clouds of vapor, so that about ten per cent. of water is lost in this way, but the economy and effectiveness of the apparatus more than make good the loss.

SPARKS.

Electric light plants are being installed in the Gerrard Mica Mines, near Ottawa.

The Annapolis Electric Light Company, Annapolis, N. S., are adding to their station plant a new dynamo.

The Toronto courts have decided against the old street railway company, *re* their claim to the possession of a perpetual franchise. The company have decided to carry the case to the highest court of appeal.

Authority is being sought for by the Toronto Street Railway Co. to enable them to extend their lines outside the city limits, to manufacture electricity anywhere in the County of York, and to manufacture for sale all kinds of electrical apparatus.

Several officers of the Toronto Street Railway Company recently made an inspection of the Ottawa Street Railway Company's lines and station. The Ottawa road is justly regarded as being perhaps nearer perfect than any other in Canada.

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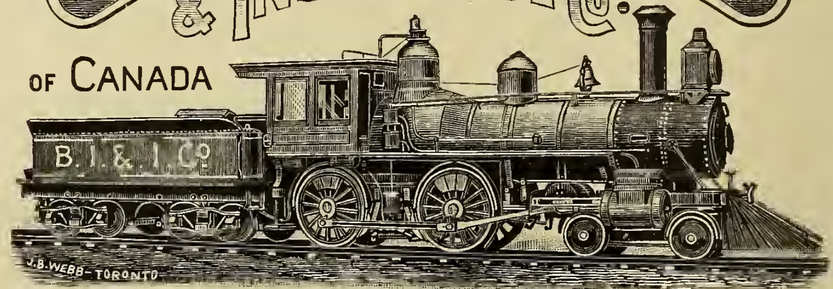

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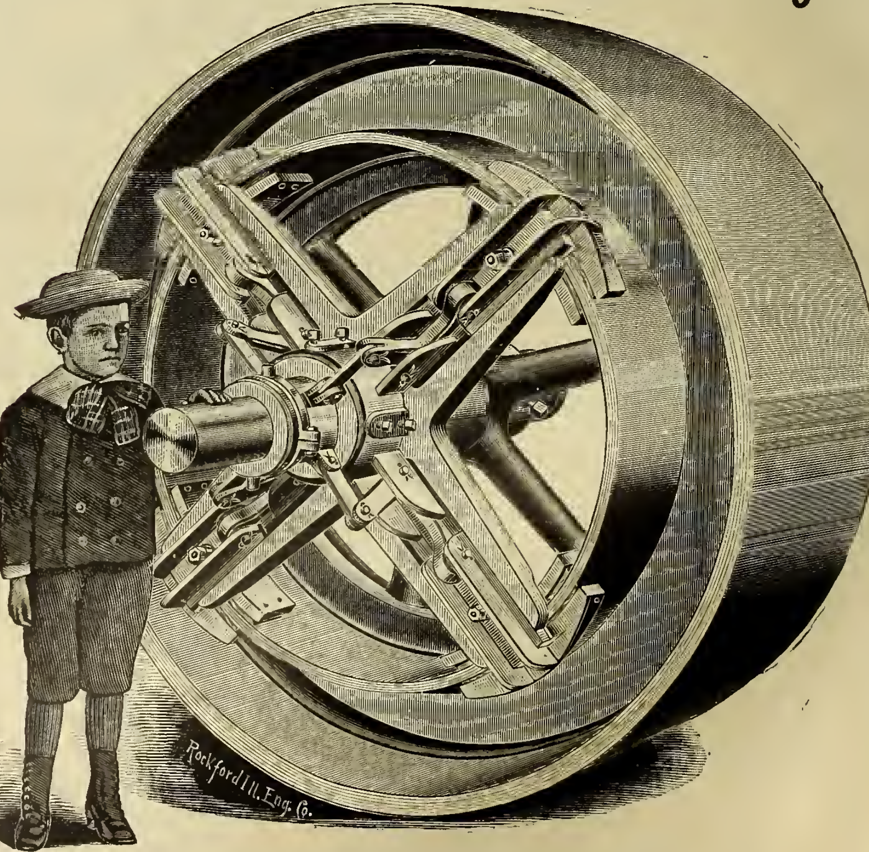
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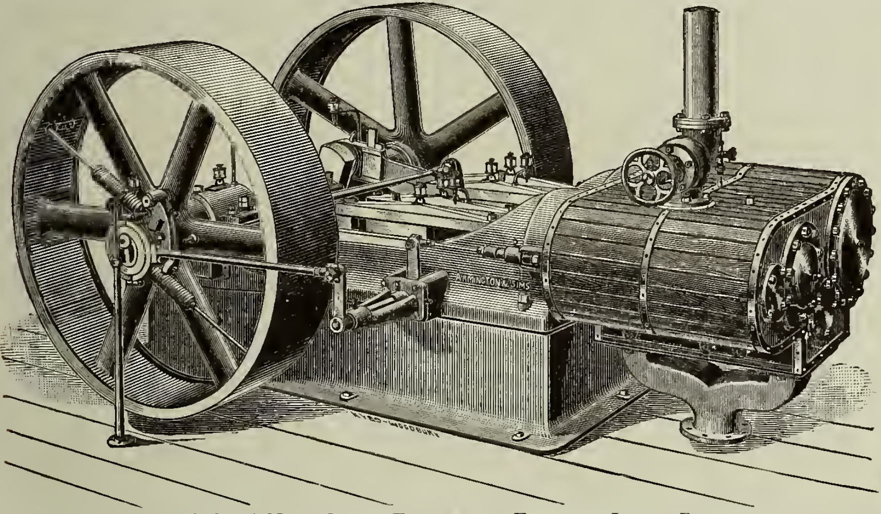

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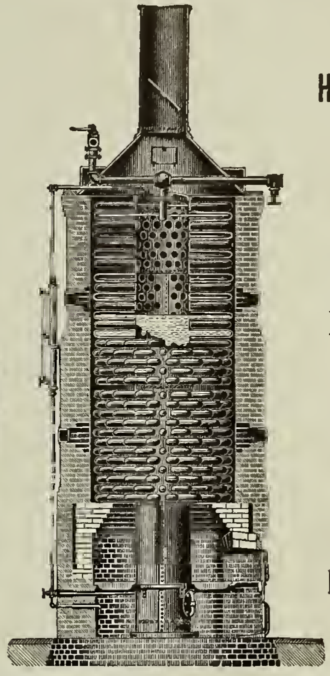

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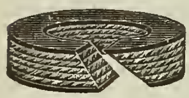
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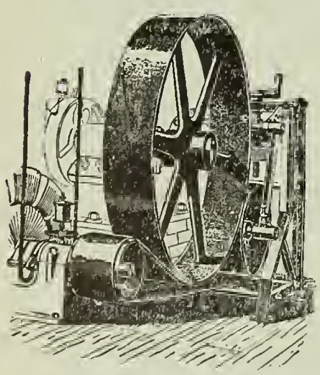

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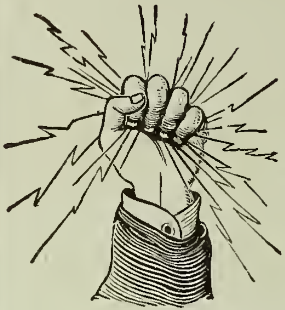

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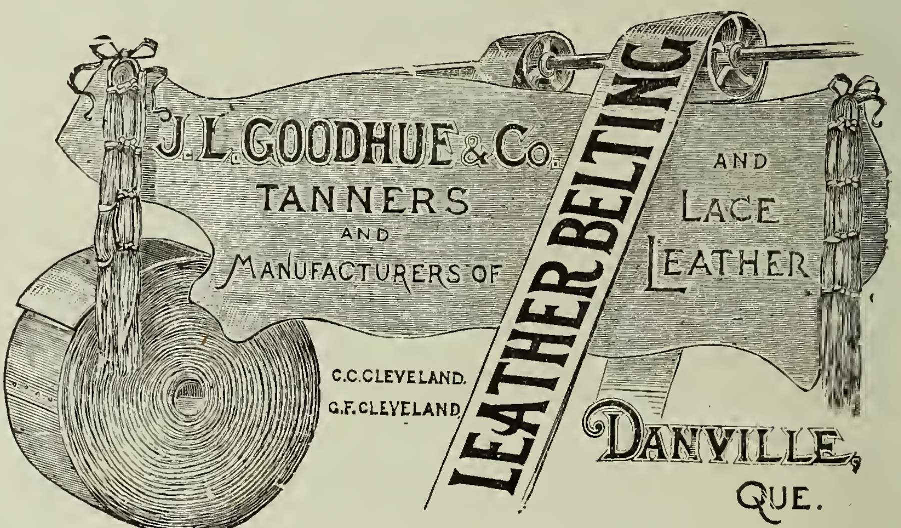

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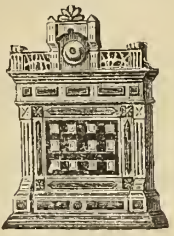

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One 36 inch belt 100 feet long. One 38 inch belt 100 feet long.
One 36 inch belt 123 feet long. One 24 inch belt 100 feet long.
And over 1500 feet of 8 inch belting.

All the above belts are DOUBLE THICKNESS and are all giving satisfaction.
The 38 inch belt is the largest belt ever made in this Province.

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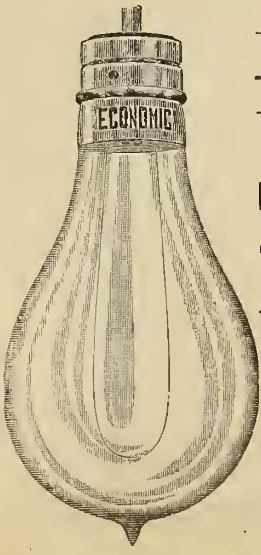

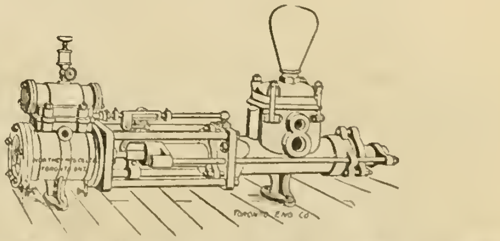

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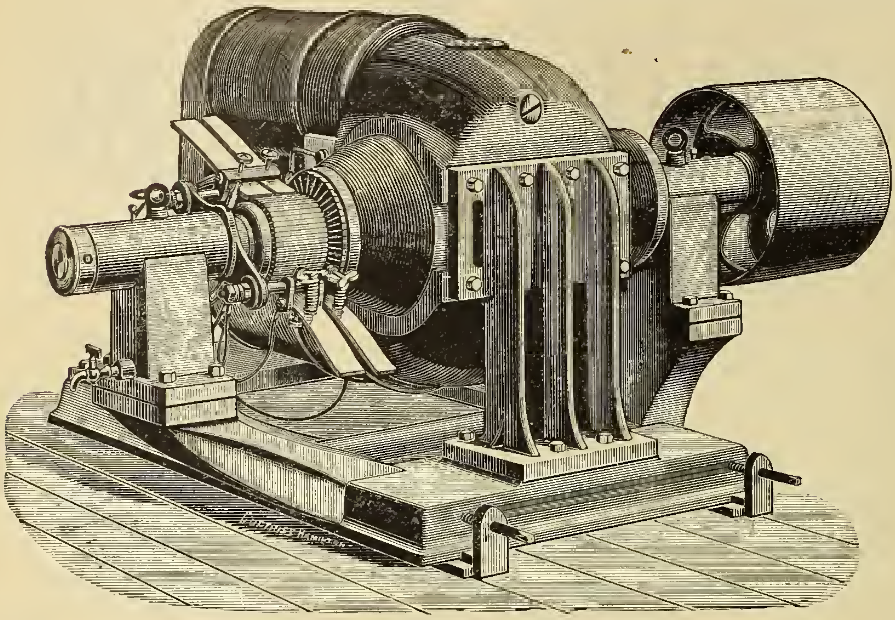

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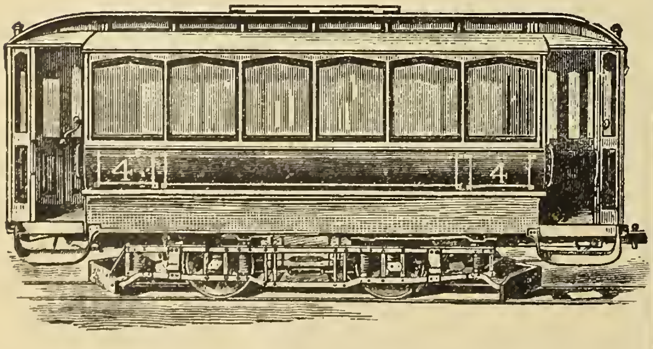

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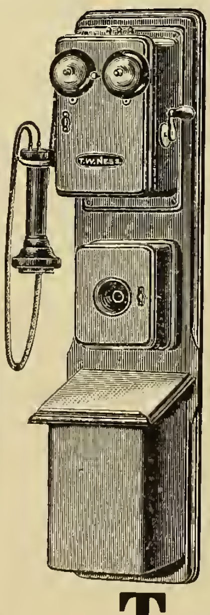

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Local exchanges fitted up. All line material supplied.

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T. W. NESS, ESQ., Montreal.

DEAR SIR,—We are happy to state that your telephones and switches are giving us good satisfaction. We have three sorts of switches and we find yours far preferable. There is now about forty of your telephones in operation on our line. Every one works well, and we intend to use no other.

Yours very truly,
THE MEGANTIC TELEPHONE CO.

Write us when you want anything electrical.

Key Sockets,	*Magneto Bells,*
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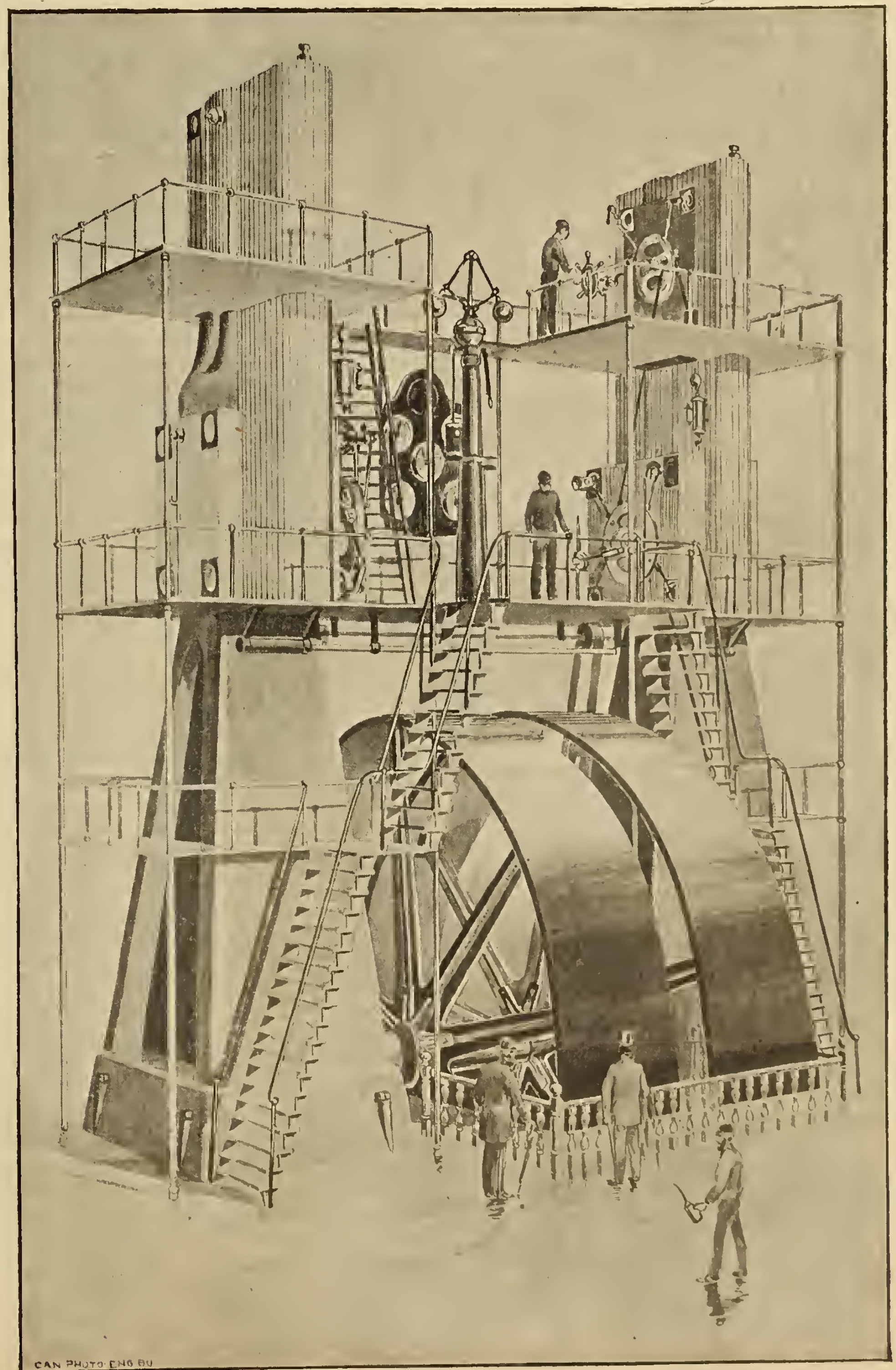
CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. III. TORONTO AND MONTREAL, CANADA, MARCH, 1893. NO. 3.

A NEW ENGINE FOR ELECTRIC LIGHT WORK.

A LARGE engine, of which the accompanying engraving gives an excellent representation, has recently been completed and put in operation at the works of the Toronto Electric Light Co. It may be described as a double tandem upright compound condensing engine, though in reality it is two complete engines combined on a single shaft, and is of the Corliss variety. It may be said to mark a new departure in this country in the development of the steam engine as applied to electric lighting. As the demand for electricity for light and power becomes more general, larger units will be required. In the near future an engine of the power and class here represented will be no larger in proportion to the output of a central station than was the fifty horse power of a few years ago. The engine in question has an easy capacity of over a thousand horse power, runs at 90 revolutions per minute, and uses steam at 120 lbs. per square inch. Steam is supplied by four water tube boilers of 250 h. p. capacity each. Two are of the Heine construction, and two of the Caldwell pattern. There are two independent condensers in connection with the engine, and ample relief valves to enable either engine to exhaust into the atmosphere in the event of trouble with the condensers. The engine is temporarily employed in driving four generators of 250 h. p. each for the Toronto Street Railway, besides arc light machines of the Electric Light Co.

If, as it is said, "imitation is the sincerest flattery," the management of the Toronto Electric Light Co. may be congratulated upon the fact that their progressive ideas are appreciated. The Royal Electric Co. of Montreal are erecting a duplicate of these engines, and it is stated that the Toronto Incandescent Company contemplate the introduction of a similar engine, though of a considerably smaller power.



A NEW ENGINE FOR ELECTRIC LIGHT WORK.

Some forms of arch work undoubtedly obstruct the heat from boilers more than others. When the demand for steam is fairly even and 24-hour fires are kept, a good deal more brick may be judiciously added. To the arch there must be some way of admitting air. It must be remembered that air goes up the chimney the easiest way, that all air above the fire takes from draft through the fire.

ANNUAL DINNER, MONTREAL NO. 1 C. A. S. E.

THE annual dinner of the above Association is always a time of much enjoyment, and as such is looked forward to with pleasant anticipations and reflected back upon with the happiest recollections. The event, which took place this year at the City Hotel on the evening of the 18th inst., was in keeping with its predecessors, if indeed it did not surpass them all.

The chair was occupied with much felicity by the President, Mr. James Robertson. The attendance numbered about 80, and included the following :

Members—Thos. Ryan, Jos. G. Robertson, Geo. Hunt, J. J. Yorke, H. Nuttall, W. McAlpine, Thos. Allsopp, P. Hayes, W. Bill, J. Elliott, H. Thompson, W. Ware, Thos. Biggs, J. Mooney, J. E. Jones, J. Willson, R. Grantham, H. Rolens, H. Weaver, R. Burgess, W. Burgess, W. Galley, J. Arthur, J. Kirwin, A. Nuttall, Ed. Hay, W. Allen, Ed. Orton, J. Robertson, O. E. Greinberg, J. Higgins, W. H. Smith, J. Strickland, J. Badger, J. Black, J. A. Price, F. Carroll, J. Burns, J. Compton, W. D. O'Brien, R. Connolly, H. Tipping, J. McParland, W. Willson, M. Rochfort, H. Latour, J. Oades.

Invited Guests—C. E. Robertson, Hugh Vallance, W. E. Gower, P. H. Couper, John Smilie, Thomas Clarke, Sam. Brickley, Jas. Labresh, Sam. Fisher, T. W. Casey, L. M. Pinolet.

Letters of regret at their inability to be present were read from Major W. H. Laurie, Capt. James Wright, A. E. Edkins, President of the Executive Board, A. M. Wickens, A. J. Darling and Robert Mitchell.

The toast of "Electrical engineering" was first proposed, and responded to by Mr. C. C. Robertson and the representative of the CANADIAN ELECTRICAL NEWS. Mr. Robertson gave a resume of the progress being made in the industrial applications of electricity and also described the magnetic clutches which were being introduced in the electrical engineering laboratories at McGill University instead of friction clutches. He created considerable amusement by his local hits and descriptions.

In response to the toast of "Steam Engineering," Mr. P. H. Couper spoke of the progress being make in steam engineering and alluded to the recent breaking of the shaft of the steamer Umbria and its repair while at sea, which could not have been done a few years ago. Some 20 years ago a pressure of 15 to 20 lbs. of steam was used where to-day many times that pressure was employed. In those days it was thought that any one was able to take charge of an engine, and the engineers were consequently a very different set of men from the engineers of to-day.

Mr. John Smiley also responded to the same toast and gave an interesting account of the engines in use when he was a boy, mentioning, as an example of the crude devices then employed, an atmospheric engine for pumping water which used a steam pressure of but 5 lbs. From the advance that steam engineering had made since then and the strides it was now making, he considered it was only in its infancy.

The next toast was that of the "Manufacturing Interests." Mr. Hugh Vallance in responding said that the Montreal manufacturers were being undersold because labor was dear and their expenses heavy, and advocated the imposition of a tax upon outsiders who sold machinery in Montreal in order to equalize matters. Mr. S. Fisher, who spoke to the same toast, did not agree with the former speaker. He said no Montreal manufacturer should be afraid of outside competition. The best way to hold trade was by excelling in workmanship. He was glad to hear that the Association was to have a course of lectures on steam engineering which would be open to the public.

Mr. W. G. Gower, of the *Engineering News*, spoke for the toast of the "Faculty of Applied Science," describing among other things the fine equipment of the engineering laboratories of this faculty at McGill University and the facilities afforded for instruction, which he said could not be excelled anywhere.

The reply to the next toast, that of "The License Law and Inspection," was the speech of the evening, and teemed with interest to even those outside the profession. The speaker was Mr. O. E. Granberg, Inspector for the Boiler Inspection and Insurance Co., who, after a short prelude, said :

We have general laws to protect life against the carelessness of those who handle drugs and poisons as well as powder and other explosives, and why should we not have a general license law for those who handle steam boilers which may be the most destructive element to life and property when placed in the hands of ignorant and careless men. I know of steam plants being run by men in some parts of the Province, who know no more about the vast power and destructive elements contained in the boilers they neglect and abuse than they do about the North Pole. To illustrate this I will relate a few circumstances that came under my observation. I called at a steam plant where they were putting in a second boiler and an engineer asked me to place the safety valves at 60 lbs., that was all his cylinder would stand. I pointed to the steam gauge on the boiler in use at the time. It stood at 80 lbs. "Oh, yes!" he said, "that is all for one boiler, but I intend using two boilers connected together with 60 lbs. of steam on each ; that will give me 120 in my cylinder." And, gentlemen, would you believe it, he appeared to pity my ignorance when I told him I could not see it, and took considerable trouble to enlighten me on the subject. I think that man would take a first class. He knew how to add 60 and 60 together to make 120. I called at another plant and found the condenser stopped. I asked the reason and was told that something was wrong with it—they got too much vacuum. I was surprised at this, as my troubles had always been the other way. I looked around and found they had a pressure gauge on the condenser. I asked about the vacuum gauge, and the engineer told me Mr. Vacuum's gauges were no good, he liked Crosby's best.

When he took charge there was a vacuum gauge on the condenser, and the engine did not work well ; so he took it off and put on a Crosby's and found he had forty pounds of vacuum. He knew that was too much ; so he stopped the thing altogether, and now his engine was all right. I felt that man was an expert in vacuums, and that it would be useless for me to offer an opinion.

If there were more such associations as this through the country where engineers are banded together for mutual improvement and instruction, and to devise ways and means to secure safety and economy, and get the best results out of their steam plants for their employers, it could not fail to be of great benefit to owners of steam plants and engineers, for there is no class of men to-day who need to understand their work so thoroughly as the engineer, and the man who takes it upon himself to run a steam plant, knowing himself to be unqualified, takes a great responsibility. The engineer holds a responsible position, one that requires his constant watchfulness, a position that requires a knowledge of his work. And yet, notwithstanding all this, I have found men wholly unfitted and unqualified for their work, with boilers just on the point of giving out, with dozens of men, women and children working around them, and that from the pure ignorance of the man in charge. I once found a man just coming out from under his boiler, after having cleaned it, and assuring me that his boiler was all right, and yet when I went under it, I found it in such a condition that money could not have hired me to get up steam on it—and I have found two men sitting fast asleep under the influence of strong drink, with a roaring fire under the boiler and the water out of sight. I would forever debar such men from taking charge of a steam plant. I feel this Association is doing a good work. It deserves the hearty support and co-operation of steam users and engineers. I am glad to see it growing and its influence for good felt.

Now, as regards inspection, I might say a good deal, but I will not take up your time to-night with more than a few illustrations, and lay before you a few facts to show you the necessity of inspection, and as I have inspected between 500 or 600 boilers during the last year I ought to be in a position to judge of its usefulness. In addition, I have condemned 11 boilers in the Province and had them taken out and replaced by new ones. I might say here that there ought to be a law to have boilers condemned by an inspector, made into scrap iron. All those 11 boilers had been running up to time of inspection. I have stopped 16 boilers for immediate repairs to be done on them, thereby rendering them safe and fit for use. I feel sure that had these boilers not been inspected some of them would have exploded and much suffering followed. I have had boilers cleaned out that had not had the hand hole covers off since they were put to work ; some of them five years ago. I have found some boilers so filled up with scale among the tubes that half of them had to be taken out to clean it. I have found plates burnt and cracked, rivets and staves broken, safety valves stuck, old iron hanging on levers to stop valves from leaking when it would take 1,000 lbs. to lift them. I have found gauge glasses and cocks choked up, blow off pipes and feed pipes so corroded and eaten near the boiler that when I touched them with a hammer it went through, and steam gauges 10 and 15 lbs. out. All these facts will show you the necessity of boiler inspection better than any words of mine could do were I to talk to you of boiler inspection all night.

I have found men who knew their work, but did not like to do it, and needed watching ; and I have no doubt but that many boilers have been kept in better order for having the inspector coming around from time to time. But I have found men who knew their work and did it well,—men who took a pride in their work, into whose boiler houses it is a pleasure to go—not a leak to be seen about the boilers or piping ; safety valves, gauges, glasses and cocks all in perfect order, everything neat and clean inside and out about the boiler. You could see at a glance that an engineer was in charge. You did not have to rub his gauge glass for half an hour in order to see if water was in it. You did not have to wade through a lot of ashes and coal in front of his boiler. He had his ashes properly taken out, and the floor between the coal pile and his boiler is swept off clear. It does an inspector good to see him take the shovel and put coal on his fire. He takes only what he can handle neatly and spreads it evenly over his fire, and he doesn't stop to tell you a long story with his furnace door open. He does not slobber his coal all over the floor, putting about half in the fire, and that all one pile, a quarter on the floor and a quarter in the ash pit to be wasted.

You may look at his ashes and you find ashes only. Go into his engine room and you do not need creepers on to keep you from slipping on the dirty, oily floor. You do not find a lot of old pipe fittings, old steam and water pipes, monkey wrenches, pipe tongs, hammers, oil cans, old boots and rubbers, paint cans and brushes, all scattered about the engine room floor, engine pounding and oil flying about, and the place half full of steam. No! You find the place clean, the floors washed, the engine running smoothly—all is clean and neat about the place and himself. I say I have found men who knew their work and did it well. Let it be said to your honor and credit that I have found the most of that class of men in your Association.

The next toast was that of the "Brotherhood of Locomotive Engineers," with which were coupled the names of Messrs. Thomas Clark, Samuel Brickley and Labrecque. Mr. Clark responded, and said he entirely endorsed the remarks of the previous speaker, considering it to be against the interest of any employer to employ an engineer who did not have an Association certificate. He said the Locomotive Brotherhood, which was organized in 1863 and was now in such a prosperous condition, did not start with such prospects of success as had the Stationary Engineers' Association. He referred to the insurance department of his Society, in which every member was obliged to take out one, two or three policies of $1,500 each, and which was of the greatest benefit to them. Since organization, the Brotherhood had paid out for death claims $3,500,000, and over $1,250,000 for assistance. In conclusion, he explained the manner in which the Brotherhood was conducted and the principles which guided them in dealing with their employers. He also alluded to the reports that had recently circulated in the press that the railway employees were preparing for a grand strike during the World's Fair. He could not answer for the other organizations, but he would answer that there will not be an unprovoked strike during the World's Fair on the part of the engineers. They would always do their duty, and the public when hearing such reports should remember the record of the Brotherhood during the past twenty-eight years. This statement was greeted with cheers by all present.

For the N. A. S. E. and C. A. S. E., Messrs. Thomas Ryan and George Hunt responded. Mr. Ryan said that the present dinner was the most successful one they had ever had, and that employers were beginning to find out that it was in their interests to employ only Association men, as the Association endeavored to educate the engineers up to a high standard so that its members would be able to render the best possible service to their employers. The question of wages never came up at their meetings, which were held solely for the purpose of mutual improvement.

Mr. Hunt, after referring to the flourishing condition of the Association and its constantly increasing membership, spoke of the question which had been raised at the Hamilton meeting as to what was the best engine for electric railways. He strongly condemned the usual practice of consulting some big theoretical engineer on such matters, as this had frequently led to the selection of a type of engine which was utterly unsuited for the purpose. The best course for those interested was to consult some good practical engineer.

Then came the toast of "The Press," which was responded to by the *Gazette* representative. During the evening songs were given by George Hunt, W. G. Gower and H. J. Weaver.

QUESTIONS AND ANSWERS.

"A. Z." writes as follows: Kindly answer the following questions in your March number:

1. Will a current indicator work equally as well on an arc circuit if placed on the outgoing or incoming wires? If not, why?

2. In running two arc dynamos in series, would they work equally as well if they were placed at the opposite ends of the circuits. Of course, this is merely a suppositious case.

3. Can you tell me why my brushes cut more under a light load than under the ordinary load. We use water power here, and the dynamos run slower when there are fewer lamps on. Is this the reason?

ANSWER.—It will make no difference where an ampere meter or current indicator is placed. The current is the same in all parts of the circuit. It should be kept out of the influence of the field magnets of a dynamo however if it has permanent magnets in its construction.

2. It would make no difference in the working of two dynamos in series if they were in different parts of a circuit. As a matter of fact they are sometimes so operated miles away from each other.

3. The cause of the sparking under light load may be for various reasons. It is probable that in cutting down the number of lights the balance of the machine is disturbed and the brushes are not at the correct neutral point of the field.

SHAFT SPEED NEEDED.

THIS table gives the least shaft speed in turns per minute for steel shafts (not given sudden changes of load or speed and not bent) of different diameters, for various horse power. It is built from the rule multiplying the desired horse power by 92 for steel and dividing the product by the cube of the diameter in inches. Thus a steel shaft 3 inches actual diameter, to give 100 horse power, should turn at least $100 \times 92 \div 27 = 340.7$ times a minute.

Shaft di'm. inchs	Cube of diameter inches	HORSE POWERS.								
		10 R P M	20 R P M	30 R P M	49 R P M	50 R P M	100 R P M	200 R P M	300 R P M	400 R P M
1	1	920	1840	2760	3680	4600	9200			
1.25	1.953	736	1472	2208	2944	3680	7360			
1.5	2.375	614	1227	1840	2454	3067	6134			
1.75	5.359	526	1051	1577	2103	2629	5257			
2.	8	460	929	1380	1840	2300	4600	9200		
2.25	11.39	499	818	1227	1636	2044	4089	8177		
2.5	15.625	368	636	1104	1472	1840	3680	7360		
2.75	30.796	334	669	1004	1338	6273	3345	6691		
3.	27	307	614	920	1227	1533	3067	6133	9200	
3.5	12.875	263	526	789	1051	1314	2628	5257	7886	
4.	64	230	460	690	920	1150	2300	4600	6900	9200
4.5	94.125	204	409	613	818	1022	2044	4089	6133	8177
5.	125	184	368	552	736	920	1840	3680	5520	7360
6.	216	153	307	460	613	767	1533	3067	4600	6133

—*Power and Transmission.*

STRENGTH OF SHAFTING.

IT is generally pretty well known that a shaft will transmit power in proportion to its running velocity, and, therefore, the faster a shaft runs the lighter it should be within reasonable limit. The use of extremely heavy shafting is not advisable under any circumstances unless actually needed to perform the work required. Some imagine, says the *Mechanical News*, that a large shaft, affording a very strong margin of safety, is the most economical to use; that, however, cannot be considered a logical and tenable mechanical position, unless tempered with sound judgment and much wisdom, sufficient of both to select properly. That there should be an ample margin of strength no one will attempt to deny, but shafting multiplies in strength so rapidly as sizes increase, that the unenlightened are apt to make the selections much too large when aiming at only ample strength margin. To show how easily uninformed mechanics may make mistakes of that kind, it is only necessary to say that a three-inch shaft has nearly three and one-half times the transmitting strength of a two-inch shaft. None unaware of the fact would ever guess at that difference and may fall into the error of selecting a three-inch shaft to safely do the work of a two-inch. To more forcibly illustrate the difference, it can be stated that a two-inch shaft, properly sustained with bearings at reasonable intervals, will safely transmit 20-horse power at 100 revolutions per minute and at the same time resent the transverse strain due to weight of pulleys and the pull of belts necessary for transmitting that much power. Under like circumstances and equally proportionate conditions, a three-inch shaft will just as safely transmit 68-horse power at 100 revolutions per minute. Shafting should never be so large as to make it absolutey rigid; on the contrary, it should be to a fair degree elastic, with an ability to give and take between the power and the work. When too rigid, unless away above all requirements in size and strength, the liability to break is increased, especially if the work is of an abrupt and severe character. Long lines of shafting, having the power at one end and the work at the other, should be graduated in size; the work end being of a size required to safely do the work and the power end larger in proportion to the length of the shaft or the distance between power and work. If such shafts be of the same size the entire length, and that a fair working size only, there will be too much elasticity in the aggregate, which will tend to gradually weaken, distort, and in the end destroy the usefulness of the shaft.

PROBABILITIES AS TO THE SUCCESS OF DISTRIBUTION OF POWER AT CONSIDERABLE DISTANCES BY HIGH TENSION CURRENTS OF ELECTRICITY.*

The subject of the transmission of power forms the fundamental problem of mechanical engineering, while the conversion of energy from one form to another is, to some extent, also considered under this branch of Applied Science. Electrical engineering extends, perhaps, over a somewhat wider field, concerning itself as it does with the three principal manifestations of energy, viz., light, heat and power.

We have at command an unlimited supply of energy in a great variety of forms, chief of which are the energy stored up as potential in coal, wood and other fuels. and the forces of nature—especially wind and water.

By means of combustion we have, so far, drawn our supply of heat, and through it also light, directly from the energy stored in fuels. The process, under proper conditions, is a fairly efficient one, too; at any rate it is as yet by far the cheapest method and almost the only one we have of producing heat, and it probably will remain so for a long time. As regards light, though the electric light is in every respect an undoubted success, we all know that it costs more than the light our grandfathers used, or even than gas. If this was a gas convention, I might dilate on the fact that in the town of Berlin, where Edison 16 c. p. lights are furnished at 10 cents per week, and gas at $2.00 net, a number of consumers have ordered out their incandescents and gone back to gas.

At the present day our greatest sources of power are our forests and coal fields, and though we pride ourselves that in this century of progress—especially so in the applied sciences—machinery in general has been brought to a high state of perfection, yet we are forced to admit that the steam engine method of transforming and transmitting energy is a very inefficient one. By it we have not been able to utilize more than 10% to 12% of the energy stored in coal, and to transmit power over any considerable distance we are obliged to transport our fuel to the point of application. The system involves a double transformation to bring it from the form of potential energy to that of power. A natural water power on the other hand we need only transmit, though this may involve a transformation. Beringer estimates the cost of water power as 1-5 to 1-10 that of steam power. If this estimate is correct we should be able to utilize much of the immense water power now going to waste and bring it to our manufacturing centers, there to furnish light or power in any desired quantity.

The problem of transmission involves two distinct cases:

(1) Distribution in small quantities over limited areas, as e. g. central station distribution.

(2) Transmission of energy in large units over considerable distance, as where a large power supply is available, but at an otherwise inaccessible place. Under this head again, two cases may arise—where all the energy is to be delivered at one place, and where considerable quantities are to be delivered at each of several places.

Of the purely mechanical methods of transmitting power there is a great variety, most of which under proper conditions and over limited distances are quite efficient. Of these, the method of belts and shafts is no doubt the best for very short distances, such as transmitting from a prime mover to a piece of machinery. Long lines of shafting, however, present some difficulty both in construction and operation, and where it is required to turn corners, both belts and shafts are cumbersome and liable to get out of order.

For greater distances wire rope is often used with good results, the best example of which is the case of cable railways. According to Beringer's table, the efficiency of this method drops from 93% at 500 meters (about ⅓ of a mile) to 13% at 20,000 meters (12.4 miles). At a recent cable railway test at which the writer assisted, we found that altogether the road was operated quite economically. Where traffic is heavy, the system is undoubtedly a good one.

Transmission by compressed air distributed through pipes is available for greater distances. One of its hindrances lies in the fact that during expansion the air absorbs so much heat that the expansion machinery is often cooled so much as to interfere with its proper working, though this can be partly overcome by heating the air before it enters the machinery at the receiving end. The efficiency of such a system varies from 55% at 500 meters to 40% at 20,000 meters, and can be increased about 20% if the air be heated. Like wire rope, its first cost is high, and its applicability therefore limited. Its principal use is in mining, though I understand a plant has been installed in Toledo, Ohio, for street car work, using a pressure of about 400 lbs.

Transmission by steam distributed through pipes and by hydraulic means may also be mentioned as among the purely mechanical methods, but their application is very limited; where gas is cheap the gas engine can be used to good advantage, in fact, it is extensively used for small power even where the gas supplied is manufactured.

The problem of distribution over a limited area is in general best solved by electrical methods, and of these the most successful is that of distribution by direct current at constant pressure. The dynamos and motors of this class, shunt and compound wound, usually have an efficiency of over 90% (*i. e.* the larger sizes), and the loss on the line can easily be made quite small, so that we may reasonably expect to have over 75% of the mechanical horse power delivered to the dynamo for actual use at the motor pulley. Moreover, the cost of such a plant is not nearly so high as with any of the purely mechanical means, and a pressure can be used which is perfectly safe. The great number of central stations now supplying power and the many electric railways are the best evidence of the success of this method. Series wound apparatus can also be used, but since the torque on the armature varies with the strength of the field and current supplied, while speed varies with pressure, a governor will be required where a number of motors with varying loads are to be supplied from the same mains.

Let us consider the requirements of the problem of long distance transmission. Any system, to be successful, must, of course, deliver power at the receiving end cheaper than it can there be produced. This practically limits the case of long distance work to cheap sources and large units. Its principal factors then are:

1. Primary cost.
2. Working expense.
3. Safety.

In electrical transmission we have at present three different methods, viz.

1. By means of direct currents either at constant potential or constant current.

2. By means of simple alternating currents.

3. By means of the three-phase alternating so-called rotary current, which received its first great trial at the late Frankfort Electrical Exhibition and which has since then been the subject of so much criticism, both favorable and adverse.

In any case, unless we can thereby effect a corresponding reduction in the working expense, coupled with a fair degree of safety, the cost of our plant must be reasonably low; this means that the machinery must be as simple as possible; further, it should consist of the fewest possible number of interdependent parts so as to reduce the liability of a break-down to a minimum, and it should not be liable to get out of order.

In all these respects, as in many others, the direct current system so far has the advantage, and we are inclined to think that very many, if not most of the cases arising in ordinary practice, can be thus dealt with by this method. True, we cannot carry a pressure anything like obtained by means of simple alternating or tri-phase currents, for, since we have no method of transforming continuous currents except by moving machinery, we must generate at the voltage used on the line. The maximum potential difference we can safely use on an armature is probably 2,000 to 3,000 volts, though some engineers claim it can be carried as high as 5,000 volts. For such high pressures, the commutator would require to have a great number of segments to prevent the current leaping across from one to another. The armature would require an equal number of coils and the whole thing would be difficult to construct. Still, 75 Kilowatt shunt or compound wound machines, carrying a potential difference of 2,000 volts, would probably work quite well; in fact, I believe there are some in use having even a larger output at this voltage. Take *e. g.*, a case where a good steady water supply of 100 to 150 horse-power is available at a distance of say 5 miles, and where we can afford to allow a loss of 20% on the line. Using a 100 horse-power 2000 volt generator, the required diameter of the line on a complete metallic circuit would be only slightly over two-tenths of an inch, about No. 4 B. & S. gauge. With an efficiency of 90% in the machines, we should still have 64 horse-power available at the motor pulley. Taking the cost of machinery as $30.00 per horse-power, copper as 20 cents per pound, poles at $4.50 per set, and allowing 35 poles per mile, the first cost of our plant would sum up to $127.00 per horse power delivered. The question of what loss to allow on the line is a very important and sometimes difficult one, since primary cost and working expense here vary inversely. Sir William Thomson, now Lord Kelvin, gives the rule that for the most economical operation, the cost of the energy wasted on the line should equal the annual interest on the amount invested in that part of the line which may be considered as being proportional to the weight of the conducting material used.

For distances where a high pressure is required, it has been proposed to use a number of dynamos coupled in series and an equal number of motors also in series at the receiving end. We could thus supply almost any desired pressure. The scheme has, we believe, been tried in France, where one of the difficulties encountered was that in case of a break in the circuit the machines were invariably burnt out. A Swiss firm have submitted plans on this system for carrying 800 horse-power from Niagara Falls to Chicago; they propose to use 10 machines of 100 horse-power, and 3,000 volts, each making a total initial pressure of 30,000 volts, and allow a loss of 24.5% on the line. Counting on an efficiency of 90% in the machines, the plant would have a total efficiency of 60%. The motors at the receiving end would drive dynamos which in turn would supply current at any desired potential difference. Taking the distance as 500 miles, we find that to get the results above stated, we should require a wire having a diameter of about .37 inch (about No. 00 B. & S. gauge) for a complete metallic circuit. The total weight of copper would thus be something over 1063 tons. All continuous current systems have the advantage that a ground return can be used, which, for the same line efficiency reduces the amount of copper to ¼ that required for a two wire circuit; this was proposed for the Niagara Falls-Chicago transmission.

Alternating currents furnish a ready solution of many of the difficulties in the problem of power transmission, but as yet we are in the position of the man of whom the German proverb says, "he had the soup but not a spoon." We are not hampered by any commutator difficulty, neither are we obliged to handle currents of such high voltage as to be dangerous, either at the generating or receiving station. We can generate at low voltage, transform by means of stationary apparatus, which requires no further attention to a high voltage, thus to be transmitted over the line and again reduced to any desired potential difference at the other end. The method involves more interdependent parts, and the first cost of such a plant is generally somewhat higher than where continuous currents are used. Further, for alternating currents, the practical resistance of a wire is not the same as for continuous currents, since periodicity and self-induction must now also be considered. It is no longer a constant quantity whatever the current, and to do the same work we may and often do require a wire of greater cross-section. Again, the E. M. F. now varies periodically between zero and a certain maximum; the effective E. M. F. is therefore only a mean, and we must insulate against a greater voltage than that indicated.

Whether it be advisable to use step-up and step-down transformers will depend on distance and the line loss we can allow. In every case the cost of the transformers must be balanced against the additional cost of copper which they save.

The ordinary motor for simple alternating currents has the great drawback that it will not start itself. When running it must be kept in perfect synchronism with the generator supplying it, the result of which is that when overloaded it comes to a dead halt, sometimes with disastrous results. The only way it can be used is therefore to start it by some independent means and bring it up to the required speed before we turn on the current; the load can only be applied after this has been done. In cases where only one motor is to be supplied from the line, and the load is a constant one, the system can be used to advantage. A notable example, and the only one of which we know, is the mining plant at Telluride, Col., installed by the Westinghouse Company. A potential difference of 3,000 volts is used and 120 H.P. are transmitted 2¾ miles at an efficiency of 75%. This plant we believe, is doing its work well; its total primary cost is given at $100.00 per H.P. delivered.

Mr. Tesla, some years ago brought out a new form of alternate current motor which has, however, as yet, not been put to practical use. The principle involved is quite simple. Take e.g. a four pole machine and excite the field by means of two separate alternating currents, opposite poles being wound on the same circuit. If we give to these currents a phase difference of 90 degrees, they will produce a resultant magnetic field which will rotate with the same periodicity as that of the exciting currents. The armature needs no commutator; its coils are all closed on themselves and the currents induced in them are of such a direction as to cause it to revolve with the resultant field. Mr. Stanly has lately devised a motor on which he uses a condenser to neutralize the effects of self-induction, and also a method by which he claims the Tesla motor can be used on any simple alternate current circuit. Still another new form is that of Ganz. It seems therefore altogether probable that we shall soon have motors which can be supplied from any simple alternate current circuit and which will do the work required of them as well as continuous current motors do now; this will certainly be a very great step in advance.

As to the merits of the tri-phase alternating current, it possesses the same advantages as the simple alternating current, in that it can be changed to any desired voltage by step-up and step-down transformers. The system received its first great trial at the Frankfort Electrical Exhibition in the summer of 1891, when the energy of a waterfall was transmitted from Lauffen to Frankfort, a distance of 108 miles. This experiment has been so carefully described and so much discussed in all the engineering papers that I need not take up time in further explanation. The underlying principle is the same as that of the Tesla motor. The armature of the dynamo is so commutated as to deliver three separate alternating currents differing in phase by 120 degrees, which currents are sent out over three separate wires. For a suitable motor we have the choice of two types, viz.: a reverse tri-phase dynamo and a machine like that of Mr. Tesla having its armature coils short circuited on themselves; the phase difference being 120 degrees there will be in this case three pole pieces. The further advantage is claimed for this system that it causes not only a definite rotation of the resultant field but also a definite direction of rotation, but we think both these points can be satisfactorily attained by means of the two phase current.

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* Paper read by Mr. E. Carl Breithaupt at the second convention of the Canadian Electrical Association, January 25th and 26th, 1893.

The first named type of tri-phase motors, like the synchronous, simple alternating motor, must harmonize in phase with the generator; it is, therefore, not necessarily self-starting, though it will start with the generator. Its fields must be excited by continuous currents. The second type will start itself, even under heavy load, and of course requires no separate field excitation; its speed is also fairly constant under variations of load. The *Electrical World* of last week contains a very interesting table of efficiency and other data for small machines of this class, compiled by the Oerlikon Company of Switzerland. With this motor the tri-phase system should be quite as commercial for central station distribution as the continuous current. Moreover, by means of specially designed motor dynamos, it can be transformed into continuous currents of any desired voltage. We could thus transform energy from a large and otherwise inaccessible source over a considerable distance and supply current either alternating or continuous at any desired potentential difference and for any desired purpose.

At the Frankfort-Lauffen plant, current was generated at a potential of 50 volts and strength of 1400 amperes. An average pressure of 16,000 volts was carried on the line, for which a copper wire 4 mm. in diameter was used —about No. 6 B. & S. gauge. The capacity of the generating plant was 300 H.P.; transmitting 80 H.P.; an efficiency of 72°/₀ was claimed. The total cost per H.P. delivered was stated to be about $282.00 of which $236.00 was for the line, leaving $46.00 per H.P. for the machinery. The machinery there used was that designed for the Lauffen-Heilbrann plant, which is now in successful operation.

Summing up then: Of the different systems now in use for the transmission of energy, in cases of any considerable distance the electrical methods make undoubtedly a better showing in point of efficiency than any of the purely mechanical methods, and they have also much the advantage in first cost. Relatively, therefore, the probabilities of success are in favor of electrical methods. Which of these is the best one, will depend on circumstances and must be decided separately for each case; it is all a matter of dollars and cents. So soon as the distance exceeds a few miles the low tension current of course drops out of consideration. For moderate distances, not over six to eight miles, we think continuous current apparatus will generally be found the most suitable. If we want to supply a number of large motors, each with varying load, the problem will be difficult, but it will be so in any case.

For long distances, the tri-phase current is, we think, at present the most suitable, and there are many instances where large water powers now going to waste could thus be utilized. Whether we shall ever be able to transmit power over such great distances as from Niagara Falls to Chicago or New York and deliver it cheaper than it can be there produced is, to say the least, very doubtful. There is no occasion for it, for, granted that it could be done, we could certainly get nearer to the source of supply, and thus effect a still greater saving.

DISCUSSION.

The President: I notice that in your paper you deal with distances of from two to five miles, and then very much larger distances, such as from New York to Niagara Falls, and from Niagara Falls to Toronto. I would like to ask you to give your opinion whether the probabilities are in favor of power being transmitted from Niagara Falls to Buffalo as cheaply as it could be generated with coal purchased thereabouts?

Mr. Breithaupt: I certainly think it can be done, Mr. President. There has been so much said about it that I purposely avoided that in my paper. I expect that within a year or two power can be delivered in Buffalo cheaper than it can be produced there by ordinary steam engines in small quantities. When you get a very large steam plant, such as a thousand horse power engine, with all the best improvements, such as triple expansion cylinders and so on, power there is comparatively cheap too, especially in Buffalo, where coal is cheap. In that case perhaps the difference between the two systems would not be great. But for ordinary machinery, in small quantities, from one or five to fifty horsepower, or anything like that, it seems to me that the Buffalo plant should be able to do business. Of course, I do not want to express a positive view, because it must be determined by the circumstances of the case.

The President: Of course my question was rather sectional. No doubt, many people believe it can be done commercially, although the experiment may not be so far advanced. At the same time, the plant that is in course of construction, and the immense force of Niagara Falls can be utilized to drive manufactories on the spot. If it is determined in the near future that the electrical business is not going to pan out, it will be very easy to drop that part of the scheme, and utilize the power of that canal on the spot, as at present they are not committed to any particular system.

Mr. Wickens: If it be possible to produce this current at the Falls and carry it to Buffalo for as little money as it can be made in Buffalo, after the line is carried to the city and you begin to make the distribution all over the city, up into this little factory, and down into that little factory, you have got to make reductions, as I understand, in this scheme. Will not there be a loss there? If this power was conducted to Buffalo, to a large station, and utilized there, then, of course, losses would occur when the current was re-made, as it were, and being distributed in that city. If the scheme will drive a large power station in Buffalo as cheaply as a large station can be driven by steam power, then the distribution from the dynamo in that station will be the same as to-day, and we know what it is. But if the scheme will not do that, will only reach places that are driven with small powers, why, we know that the cost of driving small steam power is much greater than large, and the distribution has got to go to these small ones; it is a question whether one end won't counterbalance the other, and go into the same hole it came out of almost.

Mr. Breithaupt: The only question is whether you can deliver from the dynamo at Buffalo cheaper than it is supplied by steam power there. If that transmission becomes an accomplished fact, the loss would be very small. That point does not come into the question, because if you can bring it there, then you can start a distribution plant from there just as cheap as from the other. It is a matter of electrical engineering. You can measure what the loss is in the first dynamo, and in the line, and can get at exactly what percentage of power will be delivered at the motor, and from that you can easily figure whether it will pay better than the other.

The President: I understand that soft coal, for steam purposes, can be purchased in Buffalo at from $1.00 to $1.60 per ton. If that is the case, the probabilities are that the electric company is not in it. You can figure up, of course, to a dot what it would cost per horse power, taking an ordinary well constructed high pressure engine. The amount is four pounds per horse power per hour, and the total expenditure for fuel is not very great. If you begin right at the water at Niagara Falls, you have the cost of construction of these large hydraulic works, they must pay interest on the cost of construction, and then, you must remember, there will be interest on the cost not only of the water that goes through the tunnel, but there is the water that will go through the stock, you see, that has to be figured. There is no doubt that concern will be capitalized at a much higher amount than the actual outlay. That has to be considered. Your power is going to cost you a certain amount at the Falls, and then you have a hydraulic plant to maintain, turbine wheels and so on, and machinery won't run for nothing. Then there are generators and dynamos, whatever is going to be used, they will require looking after. A large number of the members here know what it means to maintain a dynamo. Then there are the transformers, from low to high tension; the high tension transformer will of course be a destructive element. It is all very well to say that by using the alternating current it will do the work itself; those of you who have transformers will know that they, too, are ticklish cattle to handle, especially fifteen or twenty-five thousand volts. Then you have the line, interest on that outlay, construction, and cost of right of way, and all those matters to be taken into consideration, and a distributing place at Buffalo, and transformers again. So, by the time you would get it to the consumer, it is an open question whether it would pay or not.

Mr. Dwight: Mr. President, as I suppose these meetings will close to-day, I wish to say this is the first opportunity I have had of attending your meetings, and I wish to tell you how much I have been interested in the papers that have been read to-day. I have tried to keep track of almost everything in connection with electrical matters, and the consequence is that I really know very little about the thing, as the field is so large that one who tries to keep track of it all can only do so in a very superficial manner. I do not know very much about any special subject, but I try to know a little about everything, and the papers I have heard appear to me to be wonderfully suggestive. That of Mr. R. G. Black, read this morning, I think all will agree, was exceedingly interesting. One idea suggested, that there is a time when it pays to smash an electric lamp, is something new; I think we have always thought rather more of how long we could make it last. Then Prof. Rosebrugh's paper, and the last one by Mr. Breithaupt, I am sure we shall all be glad to have the opportunity of reading when printed. I think every member of the Association is deeply indebted to the gentlemen who have read those papers to us, which they have evidently taken so much pains to prepare. I have much pleasure in moving a vote of thanks to Mr. Breithaupt, for the paper he has just read.

The motion was seconded by Mr. McFarlane and carried.

TRADE NOTES.

The London Electrical Works Co., under the same management as the London Machine Tool Co., has recently commenced the manufacture of electric motors at London, Ont.

The London Machine Tool Company have recently constructed a mammoth lathe weighing about 25 tons, for Alex. Fleck, of Ottawa. It will be used in the construction of heavy machinery, such as engine cylinders, which can be turned ten feet in diameter or length. It is said that no lathe of such dimensions was ever before built in Canada.

The Ottawa Electric Light Co. have recently moved into their new station. They have materially increased their plant, and have now one of the finest arc stations in the Dominion. A feature of the plant is the use entirely of rope drives for main transmissions, erected and supplied by the Dodge Wood Split Pulley Co., of Toronto, under their patent system. There are two main drives from the water wheel shafts to main driving shafts, having a capacity of 300 h. p. each. All iron grooved pulleys are used, and the silent, positive and steady manner in which the power is transmitted, is a great satisfaction to all concerned, as well as a matter of much interest to power users in general. Engineers and mechanical superintendents who are still skeptical on the question of rope driving, would find much to interest them around Ottawa, Hull and vicinity.

HAMILTON C. A. S. E.

HAMILTON, ONT., Feb. 16, 1893.

Editor ELECTRICAL NEWS:

SIR,—At a recent regular meeting of the above association, Mr. D. Thomson, General Manager of the Hamilton Electric Light and Power Company, gave a talk on electricity. Mr. Thomson had double and single arc lamps, incandescent light volt meters, ampere meters, transformers, a small dynamo and motor all running in our hall, so that on our arrival it looked like a testing room.

Mr. Thomson, in introducing the subject, said he didn't propose to go into any extended or profound explanation of the many uses of electricity, but simply to show some of the apparatus in use for making practical application of electricity for commercial purposes. He described the method of operating incandescent light, the various methods of wiring, etc. He explained the street railway construction and operation, the nature and uses of bonds, grounds and feeders. He also clearly described the electric motor, illustrating his remarks by illustrations on the black-board, and with the motor in operation on the platform the dynamo and generator were likewise explained, as well as the different currents, how currents are made to alternate and the frequency of alternation. In conclusion he referred to one of the latest means of employing the electric current commercially, viz., for heating purposes, and described how the current was passed into a coil and how heat was produced by the resistance offered to its passage.

Mr. Thomson cooked griddle cakes by the aid of a little electric griddle and distributed them among the audience. This is the first cooking done by electricity in Hamilton.

In closing the lecturer said that he had not a particle of doubt that many of his hearers would live to see the day when coal as a means of producing heat in houses would be entirely replaced by electricity.

At the close a cordial vote of thanks was passed to Mr. Thomson for his instructive address, after which Mr. Gough, of Toronto, Mr. Black, Manager of the G. N. W. Telegraph Co., and Ald. Dewey also highly complimented him.

R. D.

LETTER OF THANKS.

Editor ELECTRICAL NEWS.

SIR,—I wish through the columns of the NEWS to convey my sincere thanks to the members of Ottawa No. 7, C. A. S. E., and especially to Bros. J. Thompson, R. Robert, A. Gaul, J. Latour, J. Cowan and——Corbett, for the very kind manner in which I was treated by them on my recent visit to Ottawa for the purpose of organizing No. 7 Association. I was through their kindness enabled to visit all the government buildings, including the Geological Department, which was most interesting; also the Patent Department, in the model room of which one could easily spend a day, looking over the thousands of models.

All the electric light and street railway power stations were visited, and my stay was made so thoroughly enjoyable that I was loth to leave when the time came. For genuine good-heartedness and sociability it would be a hard matter to beat the boys of Ottawa.

I remain, yours truly,

ALBERT E. EDKINS,
President Executive, C. A. S. E.

A GUELPH STEAM PLANT.

Editor ELECTRICAL NEWS:

SIR,—I visited Guelph a short time since, and among the steam plants in that busy little city are several which reflect credit on the engineers in charge, and should be a source of pride to the owners. One in particular, is the plant which supplies the motive power in Messrs. Bell & Co.'s organ and piano factory.

The plant consists of 3 horizontal tubular boilers as follows: One 16′ x 60″, and two 14′ x 60″, which are fed with plunger pumps and two exhaust injectors. The engine is an 18″ x 42″ Wheelock (non-condensing), which is developing 150 H.P. according to cards taken by a Thompson improved indicator, which is always connected on the engine, cards being taken every week. The lighting plant consists of two 325 light 16 c.p. 90 volt Brush incandescent dynamos and one 75 light 16 c.p. 90 volt Kay dynamo, the latter being used for day service and the former for night. The building is heated throughout by exhaust steam. The system was constructed by Mr. R. Bell, the engineer in charge, who is a member of Guelph No. 6, C.A.S.E. Mr. Bell has in operation a very ingenious little electrical apparatus for stopping his engine by any employees in any part of the building in case of accident. By simply pushing a button two magnets in engine room are caused to attract a small armature, the result of which is that a little bolt is shot, and off goes the governor belt of the engine. The result is that the steam valves are disengaged and the engine comes to a standstill. Anyone who understands the construction of the Wheelock engine will readily see how this is accomplished. The main drive is a rope transmission, and the device spoken of above is so arranged that should any of the ropes commence to break or give way, the engineer is at once notified, as the engine stops. The motto around this steam plant appears to be "Cleanliness is next to Godliness," for everything is clean and bright; there is a place for everything and everything is kept in its place. Mr. Green is justly proud of his plant, and the writer takes this opportunity of thanking him for the few pleasant hours he spent in Guelph in the company of himself and family.

Yours truly,

A. E. EDKINS.

OTTAWA NO. 7 C. A. S. E.

At the inauguration of the above association briefly referred to in the NEWS for February, Mr. Edkins, President of the Executive, addressed the members on the objects and aims of the Association as follows:

I can assure you that the Canadian Association of Stationary Engineers as a body, and myself and brother officers of the Executive Council in particular, are very proud of the engineers of the city of Ottawa for having made such an excellent start as a branch of the Canadian Association of Stationary Engineers. When I first communicated with Bro. F. Robert, with a view to forming an Association in this city, I expected that it would (if started at all) be composed of not more than 15 members. I was, to say the least, very much surprised when I received word that you had determined to organize with 34 members. This is the best start which we have had, with the exception of Montreal No. 2, which is composed of engineers of French Canadian nationality, and which started out with nearly 100 members.

Taking into consideration the size and population of the different cities, and the number of steam plants in each, this Association must be regarded as being a credit to Ottawa and to yourselves as engineers.

The main object of the Canadian Association of Stationary Engineers is to unite engineers for the purpose of instruction, and to assist members who are out of employment to secure the same. A large number of manufacturers have looked upon the Association with suspicion, believing that it was instituted for the purpose of creating strife between the members and their employers in regard to wages. This is not, nor was it ever the object of this Association. What we do in regard to the wage question is this: We hold our meetings twice a month, and after the routine business has been disposed of, an hour or more is spent discussing different problems such as are met with in the daily work of a stationary engineer. If a brother engineer meets with any difficulty with the machinery under his charge he can bring it up before his Association and get the benefit of the experience of others. To facilitate this feature most of the Associations have a small box, which is placed outside the meeting room door. If any brother wishes to ask a question, he can put it in writing and drop it into the "question box" before entering the room, and when "Good of the Order" business is reached, the conductor brings in the box to the President, who reads the questions out to the meeting. It often results that a general discussion takes place, and the member who asked the question, generally gets the information he needs, while at the same time no one knows who is asking the question. This method has given excellent satisfaction in other Associations and I commend it to you for consideration.

Each Association has also a blackboard, and we make it a point to try to have some member give something in the line of figuring out a problem at each meeting. In this way we are educating each other to fill better positions when they turn up, and also making our services more acceptable and worth more money to our employers. There are but few men who own steam plants who would not be willing to pay an engineer a little more for his services if he could prove conclusively that he had the ability to run his plant in an economical manner. There are lots of men running steam plants who have not had the necessary experience as firemen to make them engineers, and consequently are not worth the salary they are paid, even though it be small. On the question of wages, then, what the Association endeavors to do is, to unite all practical stationary engineers who have had at least three years experience in charge of boilers and engines, (or as fireman) for the purpose of meeting together socially and for mutual instruction in our calling. It would be worse than nonsense to set up a scale of wages for engineers, as what would be a fair remuneration for a man on one plant, say of 200 H. P. would be out of the question on a plant of 30 H. P. in a small factory.

What we believe is this (and the past experience of the C. A. S.E. proves its correctness), that merit will bring its own reward, and if an engineer is sober, steady and industrious and makes himself competent, he is bound to be successful in his calling. I could give you the names of engineers who were receiving wages at the rate of $9.00 per week less than four years ago, who to-day are in responsible positions, and are holding the same with credit to themselves and the C. A. S. E. These men joined the Association, attended the meetings, and took an active part in the proceedings, thereby fitting themselves for a better position, and when such a position turned up they got it.

Some people are inclined to think that owing to the rapid strides made by electricity as a motive power during the past few years engineers will soon all be out of a job. I take a far different view myself of this matter. In fact I consider that the outlook for experienced and practical stationary engineers never was better. I am aware of the fact that many small plants have been converted to electric powers, but in these places the owners nine times out of ten never did employ an engineer. Where there is water power, of course, some of these engines are replaced by motors, the current for which is generated by water power, but on the other hand large power stations are being erected all over the country, and in each of these places a staff of competent engineers will be required, and will receive good remuneration for their services.

It is becoming very plain that we must bestir ourselves, if we intend to keep up with the march of progress in steam engineering. Steam and electricity are coming into closer and nearer quarters each year, and you can hardly enter the engine room of any large factory now without seeing a dynamo, used either for lighting or power. The men who are expected to take charge of this machinery are the engineers. In this connection the benefit of these Associations again becomes apparent, as the engineer who has had experience in handling electric machinery can give practical pointers to other members who have not as yet, but may at any time be called upon to take charge of such machines.

As many if not all of you are aware, we have tried on several occasions to get a Bill passed to provide for the licensing of stationary engineers, but so far have been unsuccessful in our endeavours. Two years ago the Ontario House passed a Bill providing for the examining of and granting certificates to all stationary engineers who wished to pass. They incorporated a Board for this purpose, of which I have the honor of being a member. Quite a number of engineers have taken out certificates under the Ontario Act, but we are not satisfied yet. It is only a matter of time, and not a very long time either, before every engineer will be forced to prove to the authorities that he has had the necessary experience to enable him to take charge of a steam boiler and engine, and thus give a guarantee that the lives of employees in factories and shops are reasonably secure during their hours of toil. Some engineers fight shy of such a legislative measure, for the reason, as they say, that they lack education, without which they appear to think they would be unable to pass their examination. This is a mistake on their part. I can assure you that the Canadian Association of Stationary Engineers does not wish to secure the passage of any legislation which would put a man out of a position which he had proved his capability to fill, perhaps by many years of efficient service as engineer, even though he might be lacking in education and theory. What we desire is to elevate our calling to a fair standard, and prevent manufacturers from employing teamsters, clerks, grocers and shoemakers to fill positions as engineers. There are plenty of men who have had experience as firemen and engineers to occupy all the positions, without causing any inconvenience to the steam users in securing men who are experienced. It is not necessary for a man to be well up in theory and figures to enable him to become a proficient engineer, but if an engineer is inclined to study and work himself up in theory, in addition to his every day practice, I have not the slightest hesitation in saying that he will find himself well repaid in the shape of better wages, and a more agreeable position where there is less manual labor and more thinking. We must bear in mind the old saying, there is always room at the top. In conclusion let me say that you will be certain to have your own little troubles in the Association just the same as we have had in other cities, but these need not seriously impair your progress if you live up to the obligation which you have taken, and try to remember the fact that because a brother holds a different opinion from yourself on any subject he is not in consequence a know-nothing. Every man has his own opinion, and every man should respect the opinion of another, even though it may not accord with his own. If you keep the chief objects of this Association in view I have no hesitation in saying that you will one and all greatly benefit thereby.

I again congratulate you on the grand start you have made in organising an association in this beautiful city, and I sincerely trust that Ottawa Atsociation No. 7 may have a long and useful life before it, and that the time may never come when you shall reget the step you have taken to-night in becoming a part of the C. A. S. E.

SPARKS.

The consolidation of the three electric lighting companies at Ottawa is said to be under consideration.

Nearly 2,000 electric cars are running in the United States. Boston alone has about 100 miles of electrically operated roads. Several systems have been developed to a perfection that insures smooth and regular service. Other systems are all in the experimental stage.—*Scientific American.*

According to the decision of the Supreme Court of Minnesota, in the case of Matz vs. St. Paul City Railway Company, standing on the rear platform of a moving street car, even when there is room inside, is not, under ordinary circumstances, negligence per se, at least in the absence of any published rule of the carrier forbidding it.

The capital stock of the Hamilton Electric Light and Power Co. has been increased to $300,000. At the annual meeting held a few days ago, the following officers were elected :—R. Thomson, president ; J. M. Lottridge, vice-president ; J. V. Teetzel, Q. C., secretary treasurer ; directors, Robert Evans, Ald. D. R. Dewey, John Knox, of Hamilton, and H. M. Pellatt, S. F. McKinnon, A. H. Campbell, Toronto.

It has been known for many years that lead pipes frequently suffer from corrosion when laid in certain kinds of earth, while certain waters eat away the inside. During the discussion on a paper on "Cables" at a meeting of the students of the Institution of Electrical Engineers, Mr. A. T. Weightman mentioned the case of the Loch Katr'ne water at Glasgow. He stated that this water contained free carbonic acid, which attacked the lead, and that the fault was corrected by treating the supply with chalk. He proposed, therefore, to imbed lead-covered cables in chalk.

The silvered copper wires, as well as the gauze, employed in the brushes for dynamos have several inconveniences. On the other hand, carbon has not yet received a fair trial. A Paris manufacturer has constructed brushes formed of metal plates, from 0.2 to 0.3 millimetres thick, with a basis of copper. The plates are folded and placed one upon another, until the number is sufficient to attain the necessary thickness. These brushes are said to do away with sparks, and lessen the wear and tear of the commutator. Only experiments of long duration will enable the real value of these brushes to be determined.—London *Electrical Review.*

It is found from experience that a short fuse will carry more current than a long one before blowing. This is on account of the terminals conducting the heat away rapidly and so cooling the fuse. It is also found that the current required to blow a fuse will depend to a considerable extent upon the size of the terminals. The necessary length for a fuse will also vary with the amount of current it carries. For instance, the fuse in a line of five lamps in series on a 500 volt circuit, taking ½ ampere, need be only ⅜ of an inch long, while a 200 ampere fuse on a 500 volt circuit should be 4 or 5 inches long.

A comparison of the constituents of some of the different forms of light shows the following proportions :—

	RED	GREEN	BLUE	VIOLET
Sunlight..................	1.4	1.6	0.5	0.1
Electric Light............	2.0	1.0	0.8	1.0
Paraffin	3.0	0.06	0.2	0.1

It will thus be seen that the electric light contains a smaller number of those rays which belong to the red end of the solar spectrum, and in this respect most nearly resembles the sunlight ; next to the electric light comes the paraffin, and last of all gas. It has been proved that the rays which belong to the red end of the specrum, that is, those of the greatest wave length, are those which are most liable to irritate the retina. In this respect, therefore, electric illumination stands out as superior to its opponents.

The Montreal Auer Incandescent Light Company has been incorporated at Montreal with a capital stock of $1,000,000, to manufacture and supply electric energy for commercial purposes. The Auer incandescent light is produced from ordinary illuminating gas by a special form of burner attached to any existing gas-fitting. A cotton woven mantle, about 2 in. in diameter and 7 in. long, is dipped in a solution of the salts of a refracting metal obtained from menazite. It is then wrung out and dried over a former to give it proper shape. The mantle is then set on fire and the cotton is entirely consumed, and the heat converts the salts of the material into an oxide. The mantle is then placed over the blue flame of a Bunsen burner, which brings it instantly to incandescence. It is claimed that the cost of this light is very much less than that of ordinary gas, while the illuminating power is much greater. The inventor is Dr. Carl Auer, a native of Austria and a graduate of Heidelburg University.

Mr. Corliss used to get rid of the necessity of steam jackets, and a good many other inconvenient things, when he furnished a power plant, says *Metal.* His steam cylinders, considered in themselves as power producers, did not seem particularly economical. But the weak point of the engine he supplemented by strong points in the boiler end of his combination. His vertical tubulars were so arranged that he could get steam into his cylinder superheated enough to overcome the effects of initial condensation. He once said : "I want to sell power and power plant, but I don't care to furnish a boiler for some one's engine; nor an engine for Tom, Dick and Harry's boiler." The secret of his great economy was in the designing of every part of the plant to harmoniously combine in producing the one desired result.

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Correspondence is invited upon all topics coming legitimately within the scope of this journal.

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"THE Storage Battery—A Canadian brings it up to a state of perfection that knocks the trolley cold!" is among the latest startling information in the electrical line furnished to the public through the Toronto press. It strikes us we have heard something akin to this before.

THE Governor of New York State believes that the canals can only compete successfully with the railways in the carrying of freight, by adopting electricity as motive power. He points out that ample water for the generation of electricity is available at various points along the Erie Canal. The same could be said of the Canadian canals, and it is not unlikely that the idea will be put into operation.

THE Canadian *Patent Office Record* usually reaches us about three months behind time, the wrapper bearing the words "On Her Majesty's Service." We do not know how far a service of this character is satisfactory to Her Majesty, but to everybody interested in the subject of patents it is next thing to being no service at all. Nineteenth century methods evidently do not prevail at the Government Printing Bureau.

IN view of the amount of attention which is being drawn to various schemes for transmitting power from Niagara Falls, and as a commentary on the discussion on this question which took place at the recent session of the Canadian Electrical Association, it may be mentioned as a significant fact that the Niagara and Queenston Electric Railway Company, who intend utilizing the power of the Falls for their line, are actually building a steam power house at the lower end of the road at Queenston, thus demonstrating that the engineers of that road consider it cheaper to use steam power—although they will have a water power in operation at the Falls—than to transmit that power only a distance of seven miles.

MR. THOS. A. EDISON, replying to the enquiry of the Toronto *Globe* as to the practicability of transmitting to the City of Toronto by means of a cable across Lake Ontario, power generated at Niagara Falls, expresses the following opinion: "The laying of a power cable under water is the only practicable method of accomplishing what you desire, for the reason that an aerial line would be affected by lightning. It is perfectly practical to convey 20,000 or 30,000 horse power to Toronto from Niagara by submarine cable. The following questions occur to me, however, in this connection:—(1) Would not such a cable as the one proposed be liable to be disturbed by ship anchors? (2) Is the project commercial, and if effected could it compete with a quadruple expansion engine, with automatically stoked boilers, situated in Toronto itself? My impression is that the last named method would be the more commercial, notwithstanding the high price of coal in Toronto."

THE interior of the Toronto public library building was recently remodelled, and is in consequence much better adapted than formerly for its purpose. In view of the expense which has been put upon the building for the purpose of increasing its attractiveness and usefulness, it is to be regretted that the means have not been discovered to prevent the public reading room from being used as a place of shelter in winter by persons of the dissipated class, whose presence in some cases is so offensive as to make the atmosphere unendurable beyond a short period. Rather than be brought into contact with persons of this class and be obliged to inhale the impure atmosphere which is due to their presence, the respectable reading public is forced to forego to a large extent the advantages to be derived from frequent visits to the public reading room. We can quite understand the difficulty which may be experienced in attempting to exclude the undesirable class of persons to which we have referred, but it ought not to be an impossible task, and in the interests of the reading community it should be done.

THE City Council of Kingston is still laboring with the question of improved street railway facilities. It is evident that the advantages of the electric system have impressed themselves upon the minds of the citizens and their representatives in the City Council. While there is a strong desire to enjoy the improvements which this system would confer, there seems to be a disposition to impose such conditions as are likely to prevent any company from undertaking to introduce it. An offer has been made to Mr. B. W. Folger of a 40 years franchise, on condition that he shall pay to the city 5 per cent of all yearly receipts above $20,000. It is understood, however, that this franchise is not to apply to all the city streets, but only to those on which cars now run. It is said that Mr. Folger does not feel disposed to accept this offer, and it is probable, as stated, that more liberal conditions will be required before the citizens of the Limestone City will be able to experience the benefits of rapid electric transit.

RUMORS have been abroad of late, that a movement was on foot by the Canadian General Electric Co., for the purpose of securing control of the Royal Electric Co., of Montreal. Mr. Thibeaudeau, president of the Royal Electric Co., denies that there is any foundation for the report, which would appear to bear on its face the stamp of improbability. The General Electric Co. has already absorbed a number of smaller concerns, and owns and operates several street railways and lighting plants, which would seem to be sufficient to occupy its attention and capital. We do not believe that the entire electrical business of the country can be controlled by a single corporation, and any attempt in that direction would be likely to have unprofitable results. In this connection a Montreal syndicate is credited with being engaged in the endeavor to have legislation enacted in the Dominion Parliament which would enable them to buy up and operate all the electric light and gas companies in Canada. If such rumors were likely to be realized, a considerable proportion of the business community might well be on the look out for a country where absence of the combine system would enable them to earn a living.

THE severity of the present winter has served to call attention to the necessity for vestibule cars. The duties of the motormen in Montreal, Toronto and Hamilton, difficult enough at any time, have been rendered doubly so by exposure to snow and frost. It is to be hoped that before another winter shall arrive something in the way of protection from the elements will be provided for them. The comfort of the passengers would thereby also be promoted. In this connection we observe that a bill has been introduced into the Illinois Legislature, making vestibuled cars compulsory on all power lines, The main section of the bill is as follows: All operators of street car lines as common carriers in this State shall provide the motor car—that is, the car upon which the driver, motoneer, or gripman performs his duty—with a vestibule apartment for the protection of said drivers, motoneers and gripmen from inclement weather, said vestibule apartment to be appropriately constructed of double glass framework, so that between the panes of glass, there shall be room for a layer of atmosphere of sufficient thickness to prevent accumulation of frost on glass, so that the view of observation of said driver, motoneer or gripman shall not be obstructed. The operators of any street car lines who shall fail to comply with the provisions of this act within six months after the passage of the same shall be subject to a fine not less than $100 nor more than $500 for each and every month compliance with the the same is deferred. Any laws pertaining to common carriers of cities of this State conflicting with the act are hereby repealed.

THERE seems to be considerable difference of opinion among some of those prominently connected with electrical industries in this part of the world as to whether or not it is practicable to carry current at high voltages and over long distances and sell it at such a price that there will be a saving to the users over the cost of generating the same amount of current by the consumption of coal on the spot. One of the long distance schemes on hand is that of Mr. John Patterson, of Hamilton, who proposes to bring at least 5000 H.P. from Niagara to the city of Hamilton for the operation of electric railways and divers other uses. Whether it will be a success or not, or whether it will ever be attempted to be carried out, remains to be seen. We are in a position to state positively, however, that Mr. Patterson has a direct and positive tender from Siemens & Halske, of Chicago, in which they guarantee to transmit that amount of power at a pressure of about 18,000 volts. They also guarantee to deliver in Hamilton 73 per cent. of the power consumed at the Falls, the system used to be alternating, with step up and step down transformers, alternating current motors to be used throughout, both on the cars and on any that may be stationary. Should the undertaking be carried out, and it looks at present as though it might be, there will be great interest taken in it both in Canada and the United States, for it will be the first of its kind in America, unless the Niagara Falls scheme be started ahead of it, which would seem at this time to be extremely doubtful. True, if it can be done here, it can be done there. The Patterson scheme seems to have advanced too far to permit of a drawback. Should it fail, it will, to say the least, put Mr. Patterson in a queer position, as the company's charter has been granted, some of the stock has been subscribed for, and it only remains to begin the work of construction. This we are assured will be started in a little while, in which case the project will be regarded with world-wide interest.

FIRES CAUSED BY STEAM PIPES.

THE New York *Spectator* of February 16th has the following:

"Several theories have been advanced as to the probable cause of steam pipes igniting wood. One, that the constant heating has carbonized it, and as carbon has an affinity for oxygen, corrosion takes place and ignition ensues. Another theory, published some time ago in *Power*, attributes the result to the same cause, but by the corrosion of the steam pipes. None of these theories are corroborated by the authority of men who have spent a lifetime experimenting on this subject.

"In 1886 this subject came up for discussion in a civil engineer's club. The president requested its members to make a thorough investigation of the matter and to present papers upon the result at subsequent meetings. The writer conducted a series of experiments, and read a paper upon the result of his investigation to the club, which was accepted and ordered printed in their monthly issue. The writer, in his experiment, has ignited at will the wood coming in contact with steam pipes by allowing the water in the boiler to run low, which happens more often than the engineers are willing to admit. When one-half of the heating surface is uncovered by water the steam gets superheated, during which time the pipes are visible in a dark room by their glow. A boiler may also foam under the care of the most careful engineer, and not a drop of water will remain in it regardless of the glass gauge or the frequent tests of the petcock. A glass gauge cannot be relied upon, and the petcock will indicate water in a foaming boiler until a very small quantity of it is left. The first indication given to the careful engineer is the smell of the burning oil in the cylinder of his engine. At that period all pipes in the building are red hot. The engineer, well knowing that his employer would accuse him of neglect—and he would probably lose his position if the facts were known—he banks his fire and with a trembling hand slowly starts his pump. The engine has kept its motion, all the machines have kept running, but during that short period all the steam pipes in the building were red hot, the wood in contact with it has ignited, and the conflagration will start a little later.

"No truthful engineer will deny that at some period of his life his boiler has foamed, as no human knowledge can foresee this occurrence, but few will ever admit that the water got low in their boiler when no foaming existed. Still, the writer knows that it often occurs, and to this occurrence can be charged the heavy losses that the underwriters are called upon to pay.

C. T. AUBIN, Civil Engineer."

Philadelphia, February 6.

The signature professes to be that of a civil engineer. When we were boys we used to be told that a civil engineer was an engineer that was civil. The definition hardly holds good in this case; or if it does, then the *Spectator's* Mr. Aubin is no engineer. It is quite evident he does not belong to the Stationary Engineers, else he would not malign his brethren. He is not a blacksmith, because he can make iron pipes red hot without putting them in the fire. He is not a boiler maker, because even a boiler maker has more sense than to expect a boiler to go on quietly with its work after being red-hot and empty, and pumped full of cold water again. He claims to be able to keep the engine running steadily after every drop of water is out of the boiler. What a pity that any should ever be put into the boiler if such can be done, especially in cities where water costs so much. We have pondered over the matter, and have come to the conclusion that Mr. Aubin has either made one of the great discoveries, such as have enlightened the men of this century, or that a portion of the address given has been inadvertently left out. We suggest to our friend, the *Spectator*, that the article will be much more intelligible to steam engineers if after the word "Philadelphia" there should be added the words "Lunatic Asylum."

ENGINES FOR ELECTRIC LIGHTING.

II.

In the former article on this subject some suggestions were made as to the probable causes of unsteadiness or jerkines in the motion of electric machinery driven by high speed steam engines. These suggestions were applicable only to cases in which the machinery is driven by one engine of the single cylinder and single crank type. It is common to find such engines used, and as they are generally connected to the dynamo by belting, the jerking is aggravated by the belt slipping at times.

Variations in the load are not responded to quickly enough by the common style of engine governor, and where changes of load are frequent, or, great in amount, as compared with the whole load, the engine's speed will be constantly varying. In this respect the long stroke engine, with larger fly wheel and driving a main shaft and counter shafts, will be found to have an advantage, especially if the driving shafts have heavy and well balanced pulleys. Small variations of load will not perceptibly affect the motion of the total mass of shafting, pulleys and belts, and if the change of load be a great one, time will be required to change the speed of all the shafting, and in that time the governor will have acted on the steam supply. The governor would be much quicker in its action if it were attached to and driven by the dynamo instead of the engine; or there might be a supplemental governor on the dynamo to assist the one on the engine. Where there is a considerable amount of power required constantly, with or without extra demands during certain hours, the steadiest motion will be got by having at least one large engine driving a main shaft, from which the various dynamos may be driven by counter shafts. This large engine should have at least two cranks and two cylinders, and will be even better if made with three cranks on the one shaft.

When two cranks are used, the one cylinder has its piston at highest velocity when the other is at the turning point, and has no velocity. The average power of the two is thus made much more constant than can be got from any single crank arrangement. When three cranks are used the equilization is still better than with two, and by far the best motion is thus obtained.

All attempts to get rotary motion directly produced by means of steam have so far not been commercially successful. Hundreds of rotary steam engines have been made, but none have been used for large powers with economy. The water wheel with a good governor produces a very steady motion, and is free from the jerkiness produced by changing the reciprocating motion of the steam engine into rotary motion for the dynamo.

It has been proposed to pump water into a tank by means of a steam engine, and use the water through a turbine wheel to drive a dynamo. The same water would then be pumped back again, just as is now done in many cases with hydraulic elevators. This scheme has a more important bearing, in considering how best to provide power to meet extra demands which are made during only a few hours of each full day, and will be considered when that part of the subject is taken up.

Where space is of great value, or where in addition to unsteadiness and jerkiness in the motion, the vibration of the machinery acting through the ground on the surrounding property has to be avoided, it is found that the vertical engine of the marine type is the most successful. This type has for a number of years been used for screw propulsion on board ship and the necessity for economizing in space and in fuel used, led to improvements in design and proportion, so that it is to-day in the front rank in these respects.

The Edison General Electric Co., of New York, have made quite a number of this style, using three cylinders for triple expansion and three disc cranks on the one shaft. In some cases there is a dynamo at each end of the shaft. One of these engines, rated as being of 700 horse power, has cylinders of 16¼ inches, 23⅞ inches and 38½ inches diameter and length of stroke is 30 inches. The piston speed is 600 feet per minute—steam pressure carried in boilers is 160 pounds per square inch. Each cylinder has a cut off controlled by a governor in the disc crank. The range of cut-off is from about one-twelfth of the stroke to nearly three-quarters.

In some experiments the change of speed was less than 2 per cent. between full load and no load. This company is now proposing to use higher pressure of steam and to make quadruple expansion engines, using only two cranks and having two steam cylinders one above the other working down on each crank. When this four cylinder engine has its proper load it will probably be more economical in fuel, but there will be less steadiness in motion, and more vibration. The dynamos used are of large diameter, as the speed in revolution per minute is only about 120 when connected directly on the engine shaft. The triple and quadruple expansion engines, if run with light load will be found wasteful; and in order to keep up their high economy should be properly proportioned for the pressure of steam and load. The Edison Company have been using an electric accumulator, so that when the dynamos could produce more electricity than was called for on the circuit it might be stored up for use at another time. By this means a sufficient load for economy could always be kept on the engine.

For economy in space and in fuel and for freedom from vibration and steadiness in motion, the triple expansion vertical engine with dynamos connected directly on engine shaft is undoubtedly the best motive power yet produced. Such engines when water can be had for condensation, can be run on one pound and a half of coal per horse power per hour, that is when run with sufficiently uniform load and with boilers of the right design.

In the next article it is proposed to consider how best to provide for change of load, and to meet the extra demands made during certain hours.

ONE FOOT FALL OF WATER.

OTHER things being equal, the horse power that may be got from a stream or fall of water is directly as the amount of head or fall, that is, double the fall gives double the power. As one horse power equals the amount of work expended in lifting 33,000 pounds one foot high in one minute, or its equivalent, it follows that in order to get one horse power we must have at least 33,000 pounds of water falling one foot high per minute, or its equivalent. There will, of course, be some loss in conversion or generation, so that when we figure 33,000 pounds of falling water one foot in a minute as giving one horse power, we must understand it as meaning one maximum theoretical horse power. Practically we shall get only from sixty to ninety per cent. as much.

As the weight of one cubic foot of water is 62⅓ pounds (not 62½, as generally quoted) and that a standard United States liquid gallon practically 8½ pounds (say 7½ gallons per cubic foot), it is perfectly feasible for us to get up a set of multipliers showing the maximum horse power developable by any given number of cubic feet or of gallons of water per day, per hour or per minute falling one foot; and from this the horse power for any other fall can be obtained by simple multiplication. Such a table is here presented:

1,000,000	pounds per	minute	30.303 h. p.
1,000,000	"	hour	.50505
1,000,000	"	day	.02104
1,000	gallons per	minute	.2525
10,000	"	minute	2.525
10,000	"	hour	.0421
10,000	"	day	.00175
100,000	"	minute	25.2525
100,000	"	hour	.4209
100,000	"	day	.0175
1,000,000	"	hour	4.2088
1,000,000	"	day	.1754
1,000	cubic feet per	minute	1.8879
1,000	"	hour	.0315
10,000	"	minute	18.8788
10,000	"	hour	.3146
10,000	"	day	.0131
100,000	"	hour	3.14646
100,000	"	minute	.1311
1,000,000	"	hour	31.4646
1,000,000	"	day	1.311

With a ten-foot fall, one horse power would call for at least 396 gallons, or 51.364 cubic feet per minute, and this would go in a cubical box 3.71 feet on a side, in the clear.

Assuming that the water wheel gave out eighty per cent. of the maximum theoretical power of the water, the amount of water needed to produce an actual net horse power will be found by dividing the theoretical figures by 0.80; that is, there would be needed 4.950 gallons instead of 3.960, and so on.—*Dixie.*

SPEED CONTROL.*

There are but few classes of machinery which do not require some control to be exercised over their speed, and probably in this respect none are more rigorous in their requirements than the dynamo. It is to this point that the present paper is directed.

Confining our attention for the moment to shunt and compound wound dynamos, we can see that 1% increase in the speed must produce a greater increase than 1% in the electro-motive force, since the field strength is increased by the increased voltage applied to the shunt coils. For example, suppose that an increase of 1% in the voltage at the shunt terminals would produce ¾% increase in the field strength; this would again produce a further increase of ¾% at the shunt, which would produce ¾% of ¾% or 9/16% increase in the field strength, and consequently in the voltage. The final result is then that we have 1 + ¾ + 9/16 + 27/64, etc., as the percentage increase corresponding to 1% increase in speed; this amounts to 4%. Similarly, if the dynamo be worked at that point in its magnetization curve, at which 1% increase in the ampere turns produces 9/10 increase in the field strength, a similar calculation would give 10% variation in voltage for 1% in speed. In an actual instance, an Edison 6 kilowatt, 110 volt dynamo, varied nearly 3% in voltage for 1% in speed.

Such considerations would apparently lead to the conclusion that it might be worth while to waste rather more power in the field coils, thus bringing the field nearer to saturation, if we value constancy in the voltage.

When we consider any problem relating to the dynamical generation of electricity, such for example as the maintenance of constant voltage in spite of load variation, the fact is brought forcibly before us that the dynamo is but a part of a system through which there is a flow of energy, from the heat energy of the coal, through that of the steam, to the electrical energy of the dynamo, and thence on to the heat and light of the lamps, or the work done by motors. This energy is, as we know, indestructible, but some of it is as if it were side-tracked on the way in the form of heat in exhaust steam, heat of friction in the engine, loss in conductors, etc., so that to find our original energy we must hunt in many places for it, and add the separate parts, for that energy which is to pass on the way must be free, free at every instant for just that flow of energy that is demanded; more or less will not do; if 1,000 lamps are lighted, energy is required at the rate of 1,000, if it be supplied at the rate of 1050, the life of the lamps will be reduced, or if at 950 they will burn dull.

Suppose for example the problem is to maintain 500 volts between two mains in spite of all demands for current, power being derived from a steam engine with automatic cut-off; 100 amperes has been flowing, and the governor is holding the cut-off at such a point that the mean torque produced by the steam is that required for 100 amperes. Suppose that 50 amperes more are suddenly required on the line, the cut-off, of course, still holding to the point corresponding to 100 amperes. For the instant, the series coils compensate the inevitable drop due to the extra current; more energy is then required than is being supplied by the engine, and the result is that the rotational energy of the fly wheel and armature is drawn on to supply the difference. Suppose in this instance the engine runs at 100 revolutions per minute and has a fly-wheel 12 feet in diameter weighing five tons, in 1¼ seconds the speed would have fallen to 99 revolutions, the governor's effect not being considered. Now, the action of the governor (which we may suppose to depend on centrifugal action) is by no means simple, depending, as it does, on the position of cut-off for the new load, the speed corresponding to this position, the time required to pass from one position to the other, its dead beat quality and the effect of friction. If this governor be frictionless, dead beat, and has no time lag (this last, however, being practically impossible), and if the speed for the new point of cut-off be 98, then in one second the speed will fall to 99⅓, in 1¾ seconds to 99, and in 3½ seconds to 98½, ultimately reaching 98, and there remaining.

The principal objections that can be raised to this method of governing by speed are then that they must wait for a change of speed, accompanied, as we have seen, by a comparatively large change of voltage, to occur before they can act; they cannot act instantly, even when the change has occurred, and for each change of load there is a certain change of speed which the governor not only cannot prevent, but will even insist on maintaining. Now, the question, which seems to be well worth discussion, is, how far may these defects be remedied by another method of governing? Suppose, as in the case we have considered, a so-called constant potential dynamo receives its power directly from a steam engine, then it is clear that if friction remains the same the steam admission required depends only on the current, each current having then for the same boiler pressure, a definite position of cut-off corresponding to it.

If we have then determined these positions and arranged a mechanism so that the cut-off is immediately placed at the point corresponding to the instantaneous current, the proper energy would be supplied at every stroke to meet the demand, and no sudden accumulation of energy in the form of increased speed of rotation could occur. But the question now arises, should such a governor be allowed to assume entire control of the engine or not? that is, would it prevent an increase or decrease in speed from gradually arising? Suppose for example that the governing mechanism sets the cut-off in error by a certain amount, say 1/16″ in advance. What it would be useful to know is, whether the speed would continually diverge from its normal value, or whether it would merely change slightly and then remain constant. In order to obtain some light on this question, the following experiment was made, for assistance in connection with which I am indebted to Messrs. W. T. Lea and C. G. Milne. The points of cut-off in a Brown engine corresponding to a number of different valves of mean torque at 88 revolutions per minute were determined. In this way the two points of cut-off corresponding to 290 and 337 pounds respectively at the circumference of an 8-foot wheel were determined. The engine would run uniformly at 88 with either load with its corresponding cut-off. An experiment was then made to decide the question, what would be the effect of setting the cut-off for a 337 pound load, the actual load being only 290. The result obtained shewed that this difference in steam admission produced only a permanent increase of 7 revolutions per minute. There seems, however, to be no reason to suppose that a governor whose action thus controls the cut-oft by the load instead of by the speed, should ever make an error approaching that of substituting 337 for 290, and if so it is possible that the governor might work sufficiently well.

In the case of turbines and jet wheels it appears more probable that such a governor would perform its work satisfactorily, for if too much water were admitted, rendering the torque too great, the tendency of the increased speed produced would be to lower the impressed torque. Some curious effects are sometimes produced by special conditions in the transmission. For instance, a gas engine is driving a shunt wound dynamo which is charging accumulators; if all resistance be removed from the circuit but that of the cells and dynamo, the total resistance is low, and a very small excess of voltage in favor either of the dynamo or of the cells will produce a considerable current either way and the current is consequently very unsteady. If, however, the gas be forced to explode every time, instead of as often as is permitted by the speed regulation, the effect is that it runs at such a rate that the dynamo voltage will be just so much in excess of that of the cells that the torque produced by the charging current will be that which corresponds to the mean torque due to the explosion, after making due allowance for friction. The effect then is practically to control the speed of the dynamo, so as to make it a constant current instead of a constant potential machine.

On motion of Mr. Wickens, seconded by Mr. Thomson, a vote of thanks was accorded to Prof. Rosebrugh for his paper.

SPARKS.

Aylmer is considering a proposal to have its streets lighted by electricity.

A patent has been granted to A. H. Brintnell for an electric propulsion car.

A telephone exchange is being established at Chicoutimi, Que., by Messrs Guay & Co.

A wood-workers' journal states that electricity is likely to be made use of in saw and planing mill operations.

The Bell Telephone Company's system at Peteboro', Ont., is to undergo reconstruction under the direction of Mr. G. L. Shaeffer.

The adoption of electricity for lighting, and a telephone system, is under consideration by the citizens of Tatamagouche, N. B.

The Niagara Falls Park and Electric Railway Co., are said to be considering the question of erecting a tower on their property.

The Bell Telephone Co. has recently taken over the business of the Farmers' Telephone Co., of Waterloo, and will improve the service.

The Board of Trade of Collingwood, Ont., recommends the Town Council to duplicate its present electric lighting plant, so as to maintain the lights in case of accident.

A committee has been appointed by the city council of Berlin, Ont., to consider propositions which have been made for the organization of a new electric railway and light company.

The Toronto Public Library Board has appointed a committee to consider and report upon the best method of lighting the building. The purchase of a lighting plant is under consideration.

The C. P. R. Telegraph Co.'s operating staff at the House of Commons, Ottawa, recently depatched in one night to Canadian newspapers 173,000 words, the highest record yet attained.

Application will, it is said, be made to the city council of London, for a franchise to produce electricity for street, factory, store and residence incandescent lighting. The project is believed to be directed by the General Electric Co.

The Winnipeg Horse Car Company is appealing to the full court of Manitoba for an injunction to restain the Winnipeg Electric Company from running cars, claiming that it was given a monopoly of the streets by the City Council.

It cost the town of Windsor last year, $6,000 for electric light operated by a plant owned by the corporation. The average cost per light per month was $3.25 which is considerably above the price charged by many private companies.

W. G. Grace, secretary-treasurer of the Street Railway Company, has written to the Mayor proposing that the street railway traffic of both city and country be run on a broad system under the management of the Toronto Railway Company.

The new incandescent light company recently organized at Smiths' Falls, are getting their plant and wires into position. 400 incandescent lights have already, it is said, been subscribed for. The lights will be run all night at 1½ cents per lamp. Mr. J. H. Gould is president of the company,

A. Cronk, a motorman on the Sandwich Electric railway, recently sprang over the front of his car, and snatched from the track a little child which had suddenly stepped in front of the approaching car. The motorman saw that it would be impossible to stop the car, and took this heroic step for the purpose of saving the child's life.

The annual meeting of the Sackville, N. B., Electric Light & Telephone Co. was held a few days ago, and a favorable report of the past year's business presented. A large number of new telephones and lights have been installed during the year, and a sufficient number of subscribers secured to warrant the extension of the light circuits, for which purpose a new 600 light dynamo will be purchased. Messrs. H. A. Powell, D. G. Dickson, W. B. Dickson, Capt. Wm. Miller and Fred. Harris have been elected directors.

The Royal Electric Company, of Montreal, has purchased an adjoining property of equal extent to the land occupied by its factory and station on Wellington street. It was the intention of the company to erect buildings upon this property at once, to be used as additions to the factory and station, but owing to the lateness of the season this has been postponed till next spring. The new station will be devoted to incandescent lighting, and will have a capacity of 50,000 lights to begin with, making, with the present stations, a total capacity of 125,000 incandescent lights, 1,500 arc lights, and 200 h. p. for power. Its equipment will consist of five 1,000 h. p. vertical compound engines, each belted to two 5,000 light alternators, designed by Mr. Fred. Thomson, the electrician of the company. A special feature of these alternators is the embedding of the armature wire in the armature core so that no binding wires are required An alternator similar to these is being constructed for the Ottawa Electric Light Company, of Ottawa. and a smaller one for the Quebec and Levis Electric Light Company, of Quebec.

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* Paper read by Prof. Rosebrugh at the second convention of the Canadian Electrical Association, Jan. 25th and 26th, 1893.

MONTREAL ELECTRIC CLUB.

A very successful paper on "Outside Construction" was read before the members of the above club on the evening of Feb. 5th, by Mr. H. Woodman. Mr. Woodman transported his hearers to a supposed town where 100 horse power in motive power, 1,000 incandescent lights, and 120 arcs would be required. The central station was supposed to be located at the outskirts of the town, and Mr. Woodman in a masterly way "laid out" the different centres of distribution, showed how poles were chosen, trimmed and planted. Different reels for unrolling wire were described; also the manner in which wire was to be strung up, "bridled" from "foreign wires," dodged through trees, etc., etc.

A vote of thanks was tendered Mr. Woodman for his valuable paper, which proved of great interest to all.

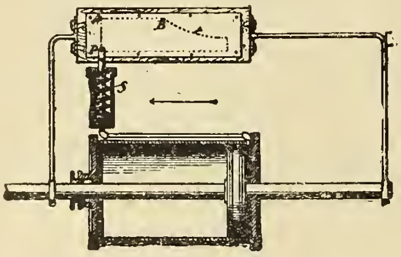
Several new members were balloted for. At the next meeting on Feb. 20th, Mr. W. B. Shaw read an interesting paper on "Storage Batteries," which is printed in this paper.

THE INDICATOR.

In a reply to an inquiry from several of our readers as to the action of the "Indicator" as used on the steam engine, says the *Northwestern Mechanic*, we have prepared the following cut and explanation, hoping that thereby the principle may be shown; although it must not be thought that the instrument used is anything like the one here shown; this merely shows the principle, In the cut will be seen the cylinder of an engine, showing the sectional view, and the piston being at the right hand end of the stroke.

The piston rod is extended out of the cylinder each way in order to make clear that the board above moves with the piston, in fact in this case is moved by it.

The board is shown supported by the arms which run up from the piston rod, and on the board is a sheet of paper tacked on to receive the card or tracing of the pencil, which is held in the place marked P at the upper end of the rod in the cylinder. It will be seen that a small pipe runs from the right hand end of the cylinder to the small cylinder and that there is free connection between the small cylinder and the main cylinder of the engine.



THE INDICATOR.

The piston in the small cylinder is a neat working fit and is forced down by the spiral spring as shown at S. Now we will suppose that steam is admitted at the right end of the cylinder (the steam chest and valve being on the side in this case) and we see that the steam having free access to the small cylinder as well as the large one, will force the small piston up; and supposing this takes place before the piston of the engine has moved at all, the line that as drawn by the pencil will be perfectly straight as shown by the dotted line on the paper tacked to the board. Now that the piston has commenced to move, and the board moving with it, it will be seen that as long as the steam pressure in the cylinder (and indicator also) remains the same, the indicator pencil remains at the same height, and the line traced will be a perfectly straight line as form A to B. Now if we let the steam follow full stroke, the line will remain straight to the end of the stroke, but as this is not good practice, we cut off at half stroke. This means that when the engine piston has traveled half of its stroke the live steam is cut off, and the steam then in the cylinder expands, forcing the piston along but of course reducing the pressure as it advances.

As the pressure begins to fall, the spring in the indicator piston forces down the pencil arm, and remembering that the board is continually moving, we can readily see that the pencil will trace a curved line' somewhat as shown. When the exhaust opens (we will suppose it to open and free the cylinder instantly) the pencil falls back to the original position, and on the back stroke traces a perfectly straight line. The dotted outline is called the card, and if we study it, we can see that it represents the work the engine has done during the stroke, the height to which the pencil went as soon as steam was admitted, represents the pressure of steam in the cylinder at the beginning of the stroke. We also see that this pressure was maintained until the piston had made half its stroke, then the gradually falling line shows that the steam pressure was becoming less, owing to the volume of steam contained in the cylinder being expanded to twice its normal volume, and finally we see the pressure line drop, showing that the exhaust was opened and the free escape of steam allowed Then we see that the height of the diagram represents the steam pressure, the point where it begins to fall, represents the point of "cut off;" and the height before the final drop, the terminal pressure, or paessure still existing when the exhaust is opened and discharged it into the atmosphere.

These exact conditions do not exist in practice, but this will serve to show the manner in which they indicate the performance of the engine.

If we know the steam pressure as it is admitted to the cylinder, we can easily read the card intelligently, but if we do not, the card has much less meaning to us.

This is arranged in practice by having the springs "S," very nicely adjusted in the following manner. A spring is made that will be compressed exactly 1 inch with a pressure of 20 pounds, this is called a "number 20 spring," another is made that will be compressed exactly one inch with 40 pounds, and called a "number 40 spring" so that you can remember, that the number of an indicator spring means the pressure required to compress is exactly one inch.

Now if we know that a 40 spring was used in taking a card, and the card measures 2 inches in height, we know that the steam pressure, when admitted to the cylinder was exactly 80 pounds, and if the height of the line at the other end of the card is ¾ of an inch, we know that the terminal or exhaust pressure must be ¾ of 40 or 30 pounds. This makes the measurement of cards entirely practical if we but know the spring employed. Revising this operation we can see if we wish to indicate an engine whose boiler pressure is 90 pounds, and we do not want our card to exceed 2 inches in height, we use either 45 or 50 spring, usually the latter, as it is best to keep the cards reasonably small.

Of course with the primitive indicator as shown in our cut, we can only indicate the right hand end of the engine, and would require two of this type to fully indicate the engine, but of the commercial kind in use to-day, it is possible to indicate both ends with the same instrument, by only changing the connection at the different ends of the cylinders. Now tracing the evolution from this crude indicator of ours to the finely finished one of the present day, we will see that the board as large as the cylinder is replaced by a very light cylinder or drum, and instead of tacking the paper for the cards to a board, we simply fasten them around this drum. This drum is revolved at the proper time to be in unison with the engine piston, by being attached by means of a cord wound around the base of the drum, to some moving part of the engine; that gives the correct motion.

The movement of the piston in the instrument of to-day is usually multiplied by a very light arm carrying the pencil over the paper and otherwise being much more simple and compact than our crude instrument, but otherwise it might be called similar.

We will at some future time enlarge upon this subject, still in a very elementary way, for we believe that this is the part to be explained and that after any one who is desirous of learning in this or any other branch has got the principle so that he can thoroughly understand it, he will need little further help from us in this way.

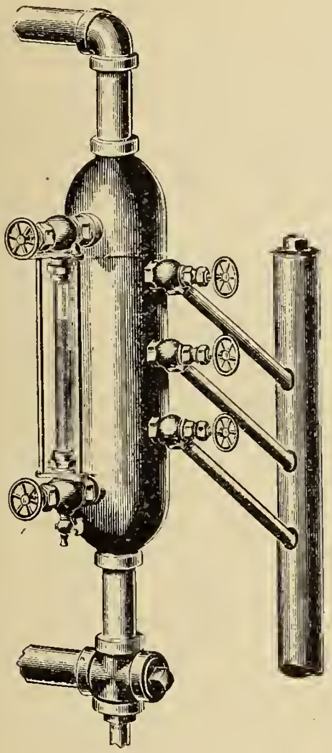
Not that we shall not take pleasure in answering any questions advanced, but we believe it is the elementary part of the subject that needs the most attention. We hope to hear from our readers in regard to this and other kindred tropics, and trust that any point not made clear will be pointed out to us that we may further enlarge upon our crude instrument and the principle it explains.

When the young fireman masters the principle of the indicator, and learns to read and understand the meaning of the cards produced, he is in a fair way to become an intelligent engineer, and to this end we desire to aid him.

CONCERING TRY-COCKS.

Try-cocks are important things, and should be so designed and arranged that they can be used with facility, and without the inconveniences and annoyances that they ordinarily give rise to. As they are usually made, they are apt to leak continually. This in itself is a sufficient annoyance to call for some remedy, and the remedy that is too often applied is to stop up each leaking one by driving a pine plug into it. The wooden handles with which they are provided crack under the influence of the heat and moisture to which they are subjected, and eventually fall off, so that the fireman has to use a pipe-wrench, perhaps, to open them. Even when they are in good condition, and the fireman tries them faithfully, he is probably rewarded by seeing a voluminous spray of mud blow all over his boiler-front; for mud will collect in the connections, even if there is none elsewhere. This trouble is avoided, in some places, by providing a copper waste-pipe, which receives the discharge from the try-cocks through small funnels brazed into it on the upper side. Such an arrangement proves very effective and satisfactory when the try-cocks are connected directly with the boiler, but when a water-column is used, and the cocks are directly over one another, it is not easy to arrange such a waste-pipe so that it shall be effective without being unsightly.

The lead or composition seats with which try-cocks are usually provided soften up under the influence of the heat to which they are subjected, especially when high pressures are used; and the fireman, in attempting to close the cocks tightly enough to prevent leakage, often jams the seats out of shape. Part of the seat is forced into the steam opening, forming a nipple, which greatly obstructs the flow of steam. In some cases these nipples are of such length that it becomes necessary to turn the cock till it nearly comes out of the thread before steam will blow through it freely. It is true that the seats can be replaced, but this will have to be done on Sunday or a holiday, when the plumber's irons are cold. Moreover, it requires some time and patience to tin the recess for the filling and get a good job.



A Substitute for Try-Cocks.

Another very annoying trouble is frequently experienced. Owing to the smallness of the nozzles of the cocks (usually about 5-32 or 3-16 of an inch), a slight deposit in them of scale or other similar substance will materially check the free flow of steam that should take place. The stems are usually not packed, and the threads are apt to fit loosely. The result of these various circumstances is that when the fireman opens the cock a spray of hot and muddy water blows out through the loose thread, and he receives it, perhaps, in his sleeve. At all events, he finds it unpleasant to use such try-cocks, and the result is apt to be that he trusts implicitly in the glass gauge, and leaves the try-cocks to themselves, plugged up, perhaps, to keep them from leaking.

There seems to be no good reason why ⅜ inch or ½ inch angle valves may not be used in the place of the conventional try-cock, for there are many advantages in such an arrangement, and there is pratically no difference in the expense. The cut shows one way in which this idea may be carries out in pratice. The angle valves are merely subtituted for the ordinary cocks, and nipples, running off at an angle, are screwed into them. A two-inch waste pipe (shown in the accompanying cut) may receive the ends of the nipples, provided the fireman is a man of sufficient experience and intelligence to know the difference between steam and water by the sound it makes, *but we should neither advise nor approve of the use of such a waste-pipe in average practice.* In most cases we should advise that the nipples from the angle-valves should open freely into the air.

By the use of angle-valves many of the annoyances incident to the common try-cock can be avoided. The stems of the valves can be kept packed, so that no trouble from leakage in this direction need be feared. A small deposit of scale makes but little difference in the efficiency of the arrangement, on account of the enlarged area of discharge; and if a troublesome deposit should collect, the bonnet of the valve may be removed, and the pipe, being conveniently large size, can be cleaned out by a small rod or a stout wire. Another point of material advantage in the proposed arrangement is that the seats of the angle valves can be easily removed and replaced by new ones in a few minutes, so that the valves can be kept tight. (It is true that these small valves usually have solid seats, but they can be had with removable seats, if desired.) Under these conditions there will be no temptation to the fireman to neglect the try-cocks.

There is one objection to the use of angle valves that should be considered, though it does not appear to us to be very weighty. In removing and replacing the bonnet of the valve the fireman is apt to use too large a wrench, and to screw the bonnet up with more force than is necessary. The result is apt to be that, after removing and replacing a few times, the hexagonal nut becomes sheared all out of form, so that it is neither hexagonal, nor square, nor round, nor any other particular shape. Then he is apt to call loudly for a new valve. This has been the experience of some few of those who have used angle valves as suggested above, but we think this trouble can be avoided by a few words of caution to the fireman.

We may mention, in this connection, another point that applies equally to angle valves and try-cocks. The tendency in these days is very noticeably towards the use of higher steam pressures than have been used in the past, and along with the higher pressures we must necessarily have higher temperatures to contend with. Thus saturated steam of 60 pounds pressure has a temperature of 307° Fah., while steam of 100 pounds has a temperature of about 338°, and at 125 pounds its temperature becomes 353°. Many alloys that will resist a temperature of 307° for long periods of time soften up so much at 340° or 350° that they soon become unfit for use as valve-seats. In such cases it is found that pure, soft copper can be substituted for the more fusible metal with good results.—*The Locomotive.*

NOVEL SUIT AGAINST A HALIFAX ELECTRIC COMPANY.

In the case of Chandler Electric Co. v. Fuller, F. was owner of a warehouse in the city of Halifax used for storing iron, and had occupied the same for some twenty years. In 1889 an electric company established a station for generating electricity on the adjoining premises. Attached to the engine used by the company in their business was a condenser, which passed through the floor of their premises and discharged into the dock below, at a distance of some twenty feet from the warehouse. In March, 1889, the warehouse was found to be full of steam, which fact was communicated to the officers of the company, who stated that they could not understand how it could have been caused by their engine. The steam continued to enter the warehouse, injuring the iron therein, and in 1890 an action was commenced by F. against the company for such damage. The company contended as a defence to the action that they were using the latest and best improvements in machinery for their business, and that they operated the same in a proper manner and without negligence; that the injury, if caused by their engine, was due to the defective state of the plaintiff's premises; and that they were acting in pursuance of statutory powers contained in their act of incorporation, and were therefore exempt from liability. At the trial judgment was given against the company, and on appeal to the full court the judges were equally divided. Held, by the Supreme Court of Canada, affirming the judgment of the Supreme Court of Nova Scotia, that the act causing the injury violated the rule which does not permit a person, even on his own land, to do an act which, lawful in itself, yet necessarily causes injury to another; and especially as the injury is continued after notice to the company, the plaintiffs were entitled to recover damages therefor.

The material and plant required for the extension of the Walkerville Electric Railway is expected to arrive on the ground shortly.

STORAGE BATTERIES, SECONDARY CELLS, OR ACCUMULATORS.*

By W. B. Shaw.

It is not my purpose to-night to discuss the above minutely, or to enter at any length into the complex chemistry that accompanies their action, but more to describe in brief how some different manufacturers construct their cells, their apparent reasons for so doing, and other points which I deem of general interest.

I will begin my remarks with what may appear to some a paradox, namely, that a storage battery does not store electricity. This can be shewn by the following simple experiment :—Place two strips of copper in a solution of sulphate of zinc. This chemical, as its name implies, is composed of zinc and sulphuric acid. Now pass an electric current through this, and the zinc will leave the compound and be electro-deposited on one of the strips, leaving the solution sulphuric acid and water. On stopping the current the zinc will be re-dissolved from the plate by means of the dilute acid, in the same manner as a simple cell, and give off a current in the reverse direction.

It is therefore a disuniting of a chemical compound by means of electricity. The atoms of this compound come together again when the current is shut off, and in this coming together cause an electric current to be given off.

In 1803 Ritter constructed an accumulator having platinum electrodes; this has long since been discarded on account of the expensive material used in its construction.

In 1860 Planté constructed one having plates of lead only. This battery has many good points, and several electricians of high standing speak well of this class.

In 1881 Faure constructed one with lead plates, the same being filled with holes, and the holes being filled up with a special prepared paste. This style has also found great favor with different electricians. Sellon's and Volckmar's, E. P. S. Julien, N. Y. Accumulator Co., Pumpelly, Sorly, Roberts, Acme, Woodward, Bradbury-Stone, Ford-Washburn and others, are of this style. The Julien Co. "temper" their lead grids by mixing a little antimony with it; the Pumpelly make their lead grids by pouring molden lead into trays of water, and afterwards filling the interstices with the paste. The Sorly make their lead grids by winding a flat strip of lead backwards and forwards, then filling in the spaces formed with the paste, finally binding the whole firmly together.

The Roberts Co., of Toronto, now defunct I believe, cast 2 lead grids, with a "star" pattern, hollow on one side. The paste is pressed into one, and the other grid placed on top and riveted to it, thus making one plate.

The Woodward (?) is made by pouring molten lead on coarse salt; the salt is afterwards dissolved out in water, and the paste replaces it.

The above are all of the Faure or "pasted plate" type. Now speaking of the Planté or all lead type, I will only mention two of the leading makes, which will serve for illustration.

The Crompton Howell, as used at McGill Colloge, use porous lead, made by maintaining melted lead almost at the point of crystallization, and then casting from the semi-crystalline mass, blocks of what may be called lead-sponge, that is to say, blocks which consist of a number of lead crystals, all held firmly together at their points of contact. These blocks of lead sponge are then sawn into plates and formed in the usual Planté method, which is by repeated charging and discharging and several reversings.

The Epstein cell is formed thus direct from lead sheets, or by direct oxidation as it is called.

All accumulators, no matter whose make or what size, give 2 volts per cell. In reality they start to discharge at about 2¼ volts, soon falling off to 1.80.

The amperes, or quantity of current delivered, depends on the number or size of the plates—that is to say, on the amount of active surface exposed to the action of the solution.

Batteries of the Faure type used for train lighting, traction and similar work, will be found usually to contain plates about 12″ x 12″ square. Where it is not convenient to ascertain the output allowed by the manufacturers they may be discharged at 3 amperes per positive plate. Thus a cell having 5 plates (3 negative and 2 positive) could be discharged without much danger at 6 amperes.

Another rule given by some is to weigh the elements, and discharge at a rate not exceeding 4 amperes per lb., all told.

When a battery of the Faure type is charging, the paste expands, and when discharging, contracts; as the lead grid, however, does not contract again after being expanded, care must be taken on charging for the first time not to force the battery, or when the paste contracts during discharge it will recede from the metal grid, and on first shaking up it receives will drop to the bottom and by degrees form a short circuit across the elements.

In regard to applying accumulators to traction purposes the chief difficulties (and they are not of minor importance) are: 1st, Buckling of plates, owing to the excessive discharge at times. For instance, a well filled car started on a grade will draw considerably more than the normal current usually taken by the motor; in fact, even if a considerable allowance is previously made in battery supply for ordinary strains, yet it is almost impossible to allow for a case as above stated. We have only to look at our Montreal service on Bleury street to see whether I am citing an impossible case.

Buckling is caused by strains either by charging or discharging at too high a rate.

Again, the bumping which cars are subject to will cause the paste of Faure type batteries to fall out, and short circuit the plate at the bottom. In the batteries of Planté or "all lead" type, the film of peroxide will also become loosened, fall to the bottom and short circuit in same manner, although they will take more time to do so. I have been criticized by some of my friends for a remark that I made in the *Witness* at the time of the storage battery excitement here. I stated that "the cold would affect the cells," not "make them into blocks of ice," as the *Witness* put it.

The objection raised was that sulphuric acid would not freeze, and that was one of the constituents in the solution. This is true, but it is also a fact that, being of greater density than water, it will settle to the bottom and the water will freeze, and even the slightest skin of ice will affect the discharge of the cell. I quote here a sentence from Sil. P. Thompson in speaking of batteries in general: "If a cell be warm it yields a stronger current than when cold. This is chiefly due to the fact that liquids conduct better when warm, the interior resistance being thereby reduced." In another part of the same work, "Elementary Lessons on Electricity and Magnetism," the same author remarks: "Pure water will hardly conduct at all," etc., "Strong sulphuric acid is a bad conductor."

Now you can see for yourselves what apparently might result.

A very objectionable feature in accumulators running in connection with a private plant is that space is generally limited, and unless said space is well ventilated, the escaping hydrogen gas evolved during charge and discharge is obnoxious and also corrosive in its action on other metals and machinery in close proximity. When a battery is charged, the positive plates assume a red, and the negatives a slate color; gas is given off freely, and the solution effervesces; the solution will also assume a milky color.

A battery's life is prolonged by never allowing it to remain wholly idle—to keep a little current running through it when not in use is good practice. *Never* discharge a battery wholly; always have one quarter of its capacity in it.

The connections between cell and cell often give trouble by the corrosive action of the acid spray (acid thrown up by the gas when charging). Lead burning or welding of lug to lug has been found the most reliable manner of connecting. Mercury cup contacts are also used; this is only applicable where cells are stationary.

Much of the foregoing has been, I am afraid, to the detriment of the accumulator, but nothing exists with disadvantages which does not also have its advantages. In electroplating the accumulator makes an excellent battery, furnishing a high amperage of current at a low E.M.F. It is also a valuable adjunct, and ought to be used, in plants working direct current constant potential systems, either 2 or 3 wire. Cells may be placed in shunt across the mains, helping to steady the current and to help the dynamo out during the hours of heavy load. An automatic circuit breaker is included to break circuit with the mains in case the E.M.F. of the cells rises too much above the E.M.F. of the dynamo. It will be seen that a shunt machine is the better to charge with, as when the resistance and counter E.M.F. of the accumulators rise, more current is forced round the fields, exciting them more and consequently raising the machine's E.M.F.

Mr. Wm. Bracken states in the *Electrical Review* of Feb. 20th, 1892, that there were 50,000 accumulators in use in the U. S. I daresay this figure has been largely augmented since then, and would have been more so but for absurd patent litigation and for the faulty practice on this side of the water of not using accumulators of sufficient capacity.

In regard to calculation of cells required we will take a supposed case. It is required to run twenty 16 c.p. 100 volt lamps for 10 hours; we will assume we use Julien cell. The above calls for a discharge rate of 10 amperes, and for a capacity of 100 ampere hours. Then 11 S. type will fill the bill, as its maximum discharge rate is 13 amperes, and its capacity is 120 hours. We will therefore need 55 cells, that is 50+5 (10% allowed in practice extra). If either double the time or double the number of lamps was required, we would require another series of 55 similar cells and put this lot in multiple with the former, or else use a cell of double the capacity. The tramways of the Seine, Paris, have lately adopted storage batteries, but there the conditions are favorable in many ways; further the Accumulator Company keep the cells in order for a small percentage annually.

Now, I think, I have already taken up more of your time than I am justly entitled to. I will be happy to answer any questions in my power, also to have the members inspect sample plates, etc., catalogues and price lists of the different companies which lie on the table. Thanking you for your kind attention, gentlemen, I will now close this paper.

PERSONAL.

Mr. W. H. Brenner, the electrical engineer of the Montreal street railway, has returned from a visit to New York and Boston, where he had gone to inspect the local power houses in the interests of the Montreal Company. It is the intention of this company to erect a power house during the coming summer, which shall be second to none in point of equipment.

Mr. Thos. Worswick, one of the ablest and best known mechanical engineers in Canada, died in the city of Guelph a few days ago. Mr. Worswick was born in Preston, England 52 years ago, but had resided in this country for many years, having been engaged until 1886 in the manufacture of steam engines and boilers at Guelph. For three or four years prior to his death he did business in Toronto as a consulting engineer. His death was the result of a severe attack of pneumonia.

Montreal, at present, pays $124.10 a year for each arc light; Toronto pays $108.59 per light; Kingston, $81; Ottawa, $80; Chicago, $100 Quebec, $30.

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* Paper read before the Montreal Electric Club, Feb. 20th, 1893.

THE DEFLECTION AND CONTROL OF GALVANOMETERS.

By E. Tremlett Carter.

The observation of the conditions of electrical stress which produce and limit the amount ot deflection in any measuring instrument is an interesting and profitable one ; and it is proposed in this paper to make a short study of the sources of the energy which produces the deflection in magnetic and thermal galvanometers, whether for measuring current or voltage. It is well known that two forces are concerned in the deflection ; one, the electrical or magnetic force of the quantity measured, which is caused by the coil or heated wire : and the other the controlling force, which is variously produced by magnetic, gravitational, or other elastic forces. In most instances the controlling force has to bring the pointer back to zero when the current ceases ; but there is an exception to this rule in the Cardew voltmeter type, in which the deflection is *produced* by the controlling spring and *cancelled* by the contracting wire. In any case, however, there is some transfer of energy when the deflection is being produced or cancelled ; and the source and destination of this energy form a very interesting enquiry. In an ideal instrument the whole of the energy which produces the deflection would be given back when the pointer returned to zero. But, in practice, owing to the perfect elasticity of the deflection—through friction—the energy is only partially restored. The frictional resistances are opposed both at the forward and at the return motion of the pointer, causing a waste of energy on each occasion.

The energy which is temporarily expended when the deflection is being made must not be confused with that constant expenditure which takes place the whole time the instrument is in circuit. The two have no necessary relationship. The mere C^2R energy does nothing useful—neither in a magnetic nor in a thermal instrument. It may at first sihht appear that the C_2R function does some useful work in a thermal galvanometer ; that, in fact, it supplies the heat by means of which the deflection is produced. But this supposition would be erroneous. The energy which does the work of the deflection is actually put into the instrument when it is manufactured, namely, at the moment the tension of the controlling spring is brought to the required amount. The *resilience* of the spring is a continual store of energy which is partially and temporarily drawn upon whenever a deflection takes place. This is restored to the spring in full amount when the heated wire cools and contracts. If we trace the passage of this energy from the instant it leaves the spring to the instant it gets back again, we shall follow a thermodynamic study of peculiar beauty. It is well known that all substances which expand on the addition of heat have their specific heats apparently raised by being subjected to increased external pressure, and lowered by being placed under tensile stress. The reason is that in our former case the expanding body does external work against the compressive force, while in the latter case the stress expends some energy in heating the expanding body. On this account, if a thin wire is heated by the passage of an electric current it will take less energy from the current, and will take less time in rising to its limiting temperature if it is under tension than if it is slack. Some of the stored heat of the wire is due to the current, but some of it is due to the expenditure of resilient energy under the relaxation of elastic stress of the spring which holds the wire tight. When the current ceases and the deflection is returning to zero, the conditions are reversed. The contracting wire expends heat on the tension spring, restoring its lost resilient energy ; and, in the ideal instrument, the amount of heat which will thus be converted into work will equal the energy originally taken from the spring. Thus it will be seen that the true C^2R function has nothing to do with the source of energy which causes the deflection. If the stress-strain diagram of the hot wire of such an ideal instrument be plotted, the curves representing a complete cycle will inclose no area ; but in an ordinary instrument this would not be the case. In such the curve of deflection would lie nearer to the axis of stress than the curve of restoration to zero ; and the area enclosed would represent loss of energy on account of friction, pretty much as the area of Ewing-cycle represents hysteresis losses.

In an electro-magnetic galvanometer the source of energy of the deflection is the electric circuit, but not through the medium of the dissipation function. The medium of exchange of energy is an electromotive force which is set up in the circuit when the needle moves. In a forward deflection there is a back electromotive force, which takes some energy from the circuit : while in the return of the deflection to zero there is a helping or forward electromotive force which restores this energy to the circuit from whence it had been taken. During the deflection this energy exists potentially in the controlling mechanism. Thus, if there is a bar-magnet control the energy is stored magnetically in the ether ; if there is a spring control, the energy exists as resilience of the spring ; while if there is gravity control, the energy exists as a stress—*where?* Would that we could say where! *Is* it the ether?—*The Electrician.*

McGILL UNIVERSITY ENGINEERING LABORATORIES.

By W. B. Shaw.

The formal opening of the McGill engineering buildings took place on Feb. 24th, under the patronage of the Governor-General. In the evening a conversazione was held, which was well attended. The writer took the opportunity, as far as was practicable, of looking over the electrical plant, which consists of the following :

The dynamo room on the ground floor contains two 30 Kilowatt dynamos, delivering current to the lamps at 100 volts. One dynamo is of the Edison-Hopkinson (English) type, and is direct coupled to a Willans upright compound engine running at 400 revs. The other machine is from Siemens Bros. & Co., London, Eng., coupled direct to a similar engine running at the same speed. These two machines bear the brunt of the work at present.

The building is wired throughout on the three wire principle, and so arranged that one dynamo only may be used when required.

The main switch board is built on wood panelling, and contains many kinds of switches, double and single pole, transfer, etc., of both English and United States manufacture, all being on slate bases. Crocker-Wheeler rheostats and Weston instruments are prominent upon it. The circuit from the Crompton-Howell accumulators, located in a room upstairs, is also brought to the main switch board.

The accumulators are themselves charged from a small Crocker-Wheeler generator, specially for the purpose, driven by a motor of the same type. An independent switch board of smaller dimensions, but constructed in the same manner as the main one, with Nalder Bros.' instruments, automatic break switch, etc., is situated near the charging generator. All wires run from the main switch board to a distributing board, where the different circuits throughout the building are branched off. Other machines have been placed in position, but have not yet been allotted their respective loads :—Two No. 4 Edison generators, one No. 8 Edison generator, presented by the Canadian General Electric Co.; one T. H. arc dynamo, presented by the Royal Electric Co.; one motor type direct current dynamo, 200 light, presented by the T. H. Electric Co.; Lynn, Mass., also several English machines of various types.

A special feature in this room is the electro-magnetic shaft clutch designed by Prof. Caius-Wilson. Circumstances, however, did not allow of a test being made as to the amount of current required by them. Small Carpenter enamel rheostats are used in conjunction with the clutch arrangement. The foundry is lit by Ward arc lamps.

The electrical laboratory upstairs is complete with test instruments, among which are Aaron electricity meters, Shallenberger alternate current meters, Elliott's testing sets and Wheatstone bridge, Nalder Bros.' volt and ammeter, also Weston's, etc., etc. The magnetic laboratory and temporary photo-meter room is situated on the floor above this again. The passenger elevator is operated by an Edison motor, and different sizes of Crocker-Wheeler motors are used throughout the different workshops in the building.

The physics building is also lit from the engineering building plant, at 95 volts, an equalizing coil being used in this circuit.

Prof. Cox's laboratory, containing many valuable physical instruments, is in the building. A large Wimshurst influence machine, Rhumkoff coil, sets of Geissler tubes, etc., are to be seen in the Professor's collection.

With such a plant at hand it will be strange if some prominent electricians are not produced from McGill in the near future.

NOTES.

G. H. Evans, of St. John, N. B , has been granted a patent for a steam engine governor, and T. W. Mount, of the same city a patent for a steam engine load regulator.

Messrs. A. M. Wickens and John A. Wills have been appointed representatives of the Canadian Association of Stationary Engineers on the Board of Management of the Toronto Technical School.

Mr. J. G. Campbell recently gave a very interesting illustrated lecture before the members of the Stationary Engineers' Association of Kingston, on dynamos, motors and the various systems of electric lighting.

The Association of Stationary Engineers, of Kingston, will apply to the local legislature at its next session for legislation which will make compulsory the examination and granting of certificates to all who take charge of steam boilers.

At slow speed a heavy leather belt takes the power of the motor to the machine. As speed increases, the same equivalent of power is conveyed by a slighter pull, and Sir Robert Ball shows that a belt as light as sewing cotton, running at the speed of a rifle bullet, will carry a horse power; while if it were possible to run a belt of the lightest line known—the spider's web—with the velocity of light, it would carry something like 250-horse power.—*Invention.*

In view of the prevailing impression that the compound engine is unsuited for varying loads, it is interesting to notice that in a test of the comparative variation in economy with change of load in simple and compound engines, reported at a recent meeting of the American Society of Mechanical Engineers, Professor Carpenter found that for a given variation from rated capacity the compound was less affected than the simple engine, while Professor Peabody reported at the same meeting, test of a triple expansion engine showing a variation of fifty per cent from a very light to an average load, with a variation in efficiency of but nine per cent.—*Power.*

One of the most common abuses to which boilers are subjected is the introduction of feed water at the bottom of the boiler. You ask, "why?" Feed water, unless a heater is attached, is usually of low temperature, and often cold. Water is no exception to the law that compels heated bodies to rise—for so being expanded—is lighter, and the cold water, obeying the law of gravity, instead of rising and mingling with the heated water above it, maintains its level and flows along the bottom of the boiler till its temperature is equal to the rest when it rises to make room for colder. The effect of the cold water is to suddenly contract that portion of the boiler with which it is in contact and thus weaken the rivets and plates, and ultimately, cause them to give way. The effect is not always noticeable at first—often requiring years to do its work, but again, the contraction is sometimes so marked that the bottom seams will leak as soon as the pump is started and stop when taken oft—the only thing to prevent a rupture being the toughness of the rivet and shell. If a practical demonstration of the effect of contraction is desired, pour cold water in a red hot kettle. Feeding water at the side, although not so injurious as at the bottom, is reprehensible. Some of the foremost builders allow it to be introduced at the top only, and before it can settle to the bottom it is thoroughly heated and no contraction of the shell follows.

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NOTES.

In the matter of inventions it is a curious fact, says the New York *World*, that Professor Bell's latest device of importance, the "waterphone," for locating leaks in water pipes, was suggested to him by observing a plumber's apprentice endeavoring to find a leak by means of a small steel rod which he held in his mouth and touched against the pipe.

An excellent method of cooling hot bearings is said to be to keep in a handy place a pint bottle of ammonia, and when the box gets so hot it is liable to fuse the metal, pour the ammonia in quite liberally, but not extravagantly, and then follow it up with a free use of good oil. In case bearings are adjusted too close, slightly loosen the bolts holding down the cap, when there will be no necessity for shutting down the engine.

The maintenance of a constant water level in a boiler conduces to economy in fuel and repairs as well as providing dry steam at all times, owing to the possibility of carrying, without danger, a lower level of water, thus insuring dry steam, and by the use of dry steam it is well known that more power can be developed from a given quantity of water evaporated, and less lubricant will be required for reducing the friction of the working parts in steam chest and cylinder. — *Wood Worker.*

A French engineer has invented a new crank, which he claims does away with the dead point. The crank-pin works in a slot cut in a steel disc fastened to the end of the shaft, and is pressed upon by a spring, which is so adjusted that, at the ordinary working steam pressure, it is held firmly in place. If, however, the crank be at a dead point, when the full pressure of the steam is admitted into the cylinder the spring is compressed, the crank-pin slides in the groove so as to assume an angular position to the shaft, and the latter begins to revolve. As the pressure of the steam in the cylinder while the engine is in motion is less than that in the boiler itself, as soon as the shaft begins to turn, the pressure against the spring is relieved, and the crank-pin flies back to its usual position. The tension of the spring is adjusted as necessary.

A correspondent of the Boston *Journal of Commerce* writes: "We have in use, among others, an eight inch belt running off a high-speed engine governor pulley, which has caused no end of trouble. It has run five or six years, and has by degrees become almost saturated with oil. Although washed several times the second night after washing it was ready for another treatment, as the washing did not take out the oil. As an experiment we tried chalk. The effect was instantaneous. By holding a good-sized piece of the aforesaid article against the belt while in motion, after awhile using a scraper and scraping it off, then applying the chalk again, and repeating the operation every hour, we found the desired effect was produced, putting an end to the trouble. It is the best thing I ever saw used on a belt that cannot be taken off and put through a process to extract all the oil and grease."

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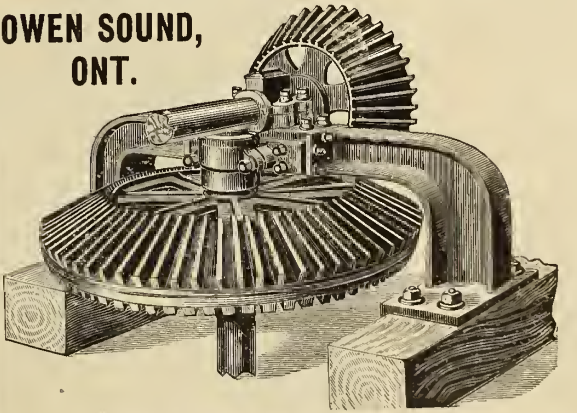

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NOTES.

Recent experiments have been made with ramie fibre as a substance for making steam pipes. The material is subjected to tremendous hydraulic pressure, and being unaffected by moisture, will neither shrink nor swell, besides being a non-conductor of heat. These pipes are said to have twice the tensile strength of steel pipes.

Tighteners.—Tighteners are mostly required in cases where belts are running on pulleys largely differing in size. They should be run near to the smaller pulley, whether it be the driver or driven, provided, of course, it is practicable to do so. There may be cases where the tightener cannot be applied close to the small pulley. The object of having the tightening pulley closest to the smallest of the two pulleys, is to use it for the purpose of increasing the lap of the belt on the pulley.

In considering the matter of the value of a coal for boiler purposes, says the Boston *Journal of Commerce*, the rate of combustion of the coal is too often overlooked by the careless engineer, who, glancing at what appears to be a hot fire, immediately concludes that is all there is to be desired. The reason why so much bituminous coal is used where a mixture with other coals might be economical, is because of the slow rate of combustion of the poorer fuel. It is not possible to get as much power from a boiler with hard coal as soft, and the harder the coal is and more difficult to burn the less will the power of a given boiler be. An engine must have the steam, and if a slow-burning coal is to be used, no matter how hot a fire is obtained, extra boiler power must be provided because the boilers are less efficient as steam producers. If a coal is twice as hard to burn, twice the boiler capacity will be required to supply steam, and this requires the outlay of an extra large plant and its maintenance, and in the most of our mills the preference is not to extend the size of the plant, hence the large use of bituminous coal. Mr. Barrus found that the labor and coal to produce 1000 horse power in a day was much less with a mixture of pea and dust and culm, and that Nova Scotia culm would produce 1000 horse power at a less cost than Cumberland, but the greater amount of steam produced by the boilers using the Cumberland coal was an advantage that the cheapness of the other coals could not overbalance. The harder a coal is to burn the less its adaptability for boiler uses from a practical standpoint. This is one thing the Nova Scotia coal must compete against.

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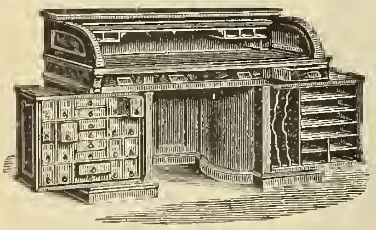

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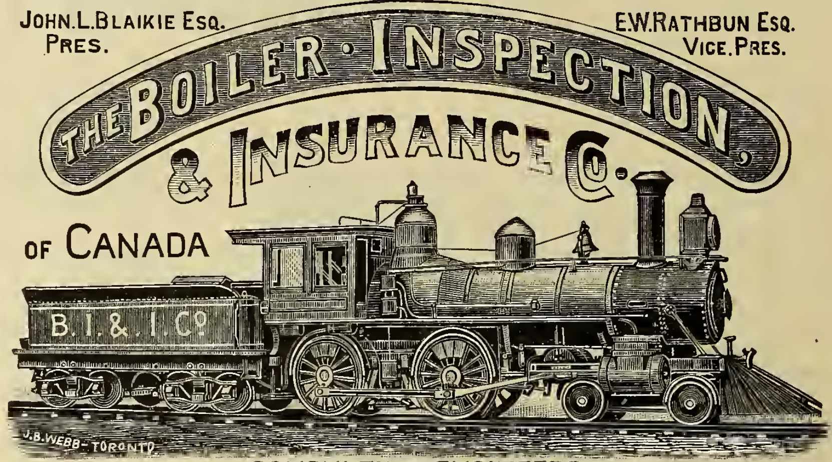
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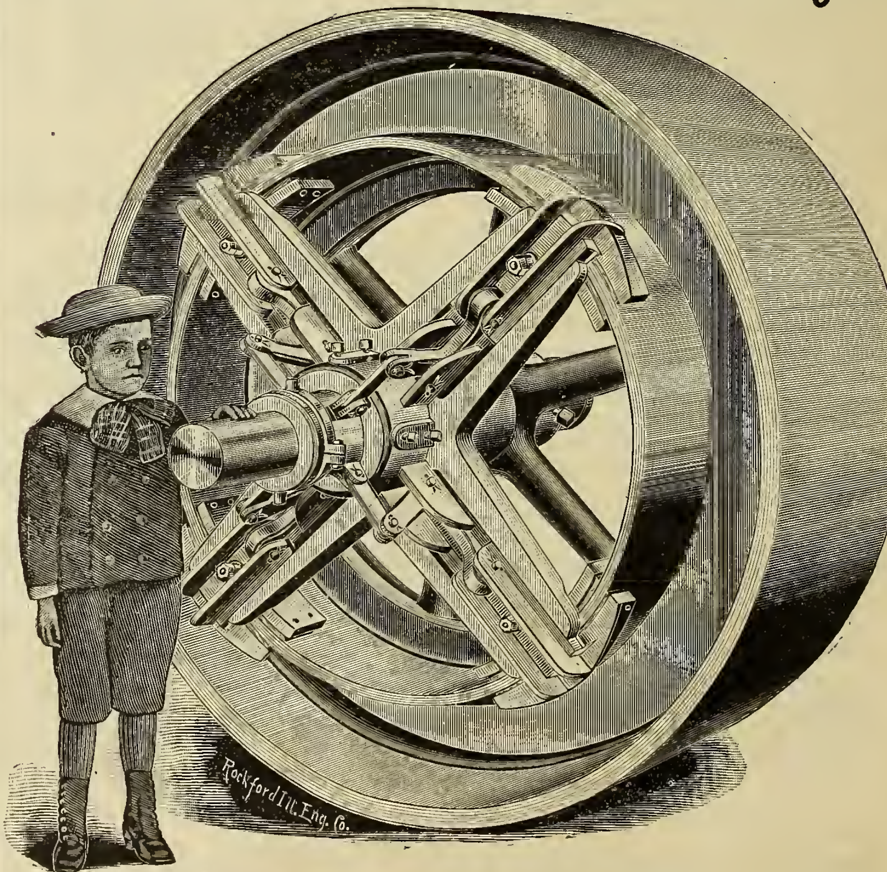
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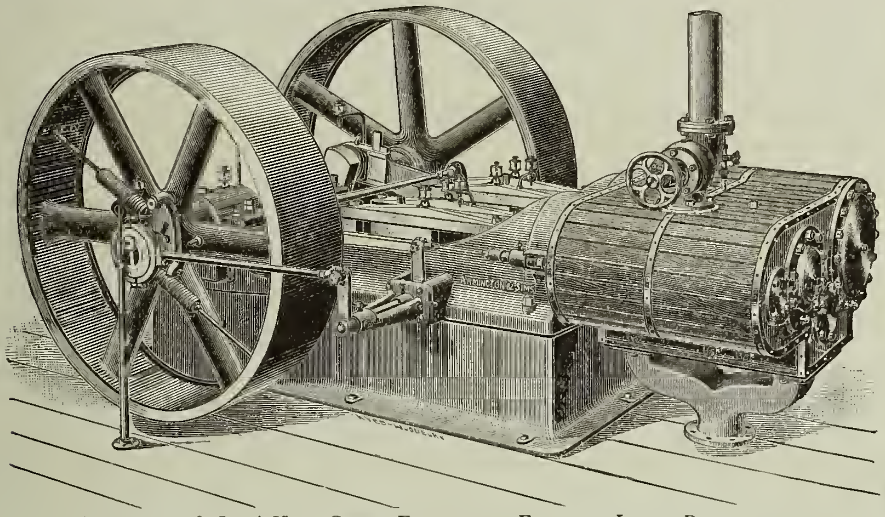

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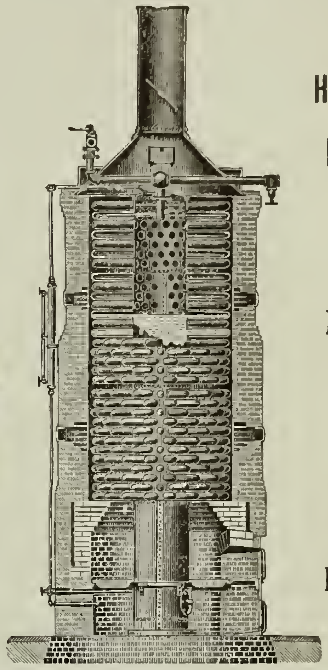

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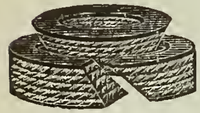

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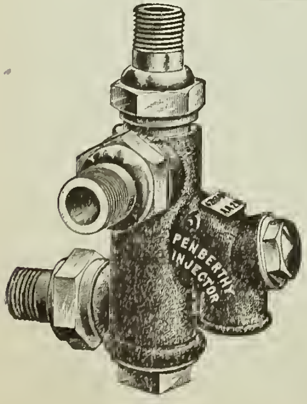

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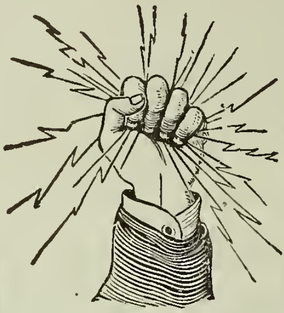

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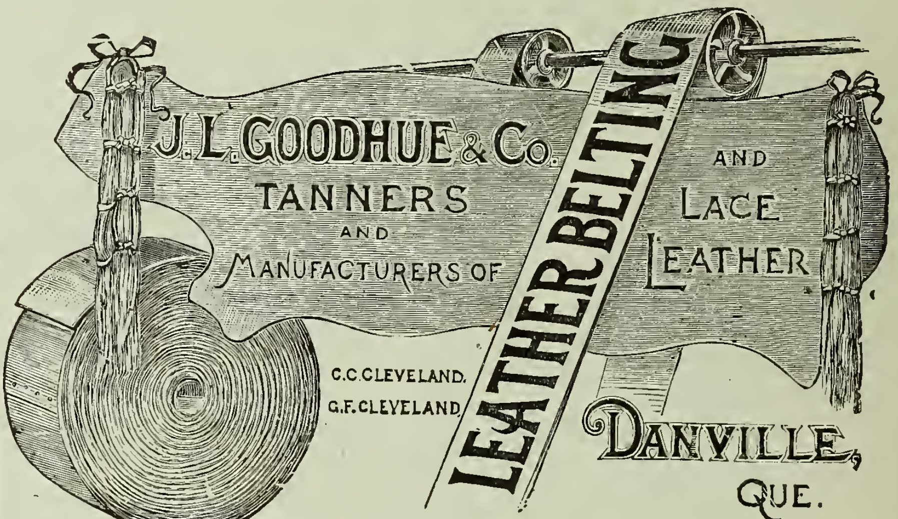

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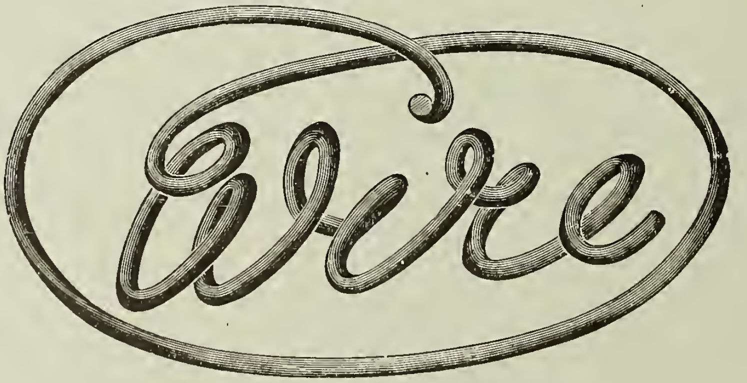

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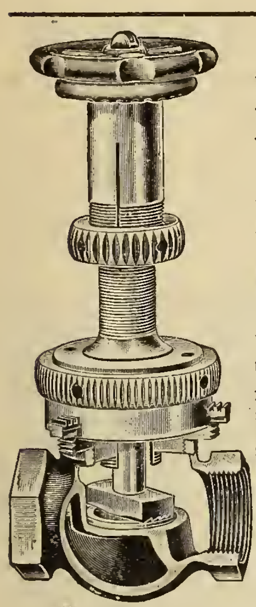

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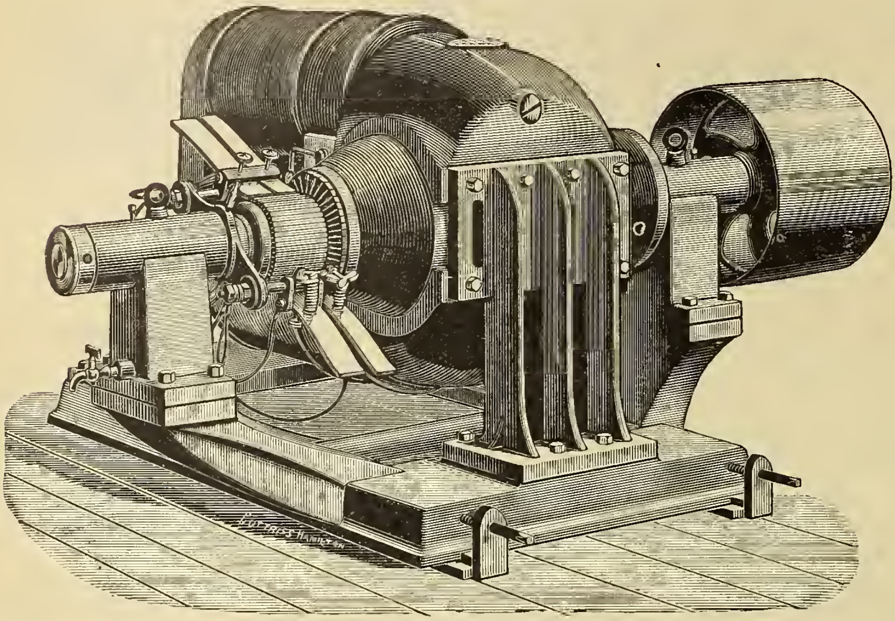

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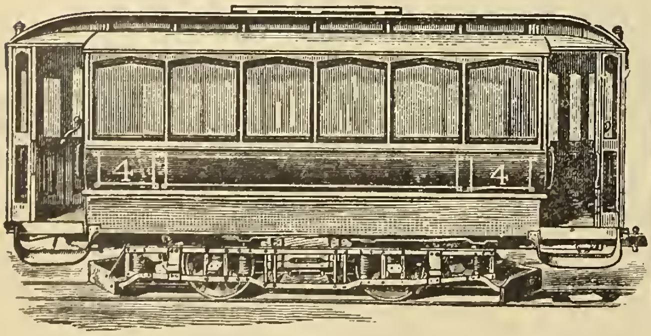

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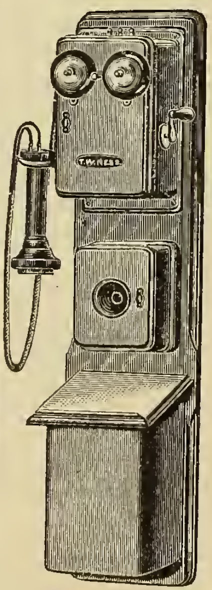

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VOL. III. TORONTO AND MONTREAL, CANADA, APRIL, 1893. NO. 4.

THE NEW WESTINGHOUSE STOPPER LAMP.

In our last issue mention was made of the invitation extended by the Westinghouse Company to its friends to inspect the machinery to be exhibited by it at the World's Fair, and also to inspect the new stopper lamps, a large number of which are burning at the shops in Alleghany.

We have fully described the machinery and have also had occasion to refer to and describe the new lamp in our issue of Oct. 26, 1892, but we think our readers will be interested in some exact photographic reproductions which we give on this page and which, for the first time, show accurately all the details of the new lamp. It will be noted that the stopper, consisting of glass, has the leading in wires passed through it for a distance of an inch and a quarter. This length allows of a perfect seal being obtained. The leading-in wires are of iron, and a special glass is employed, the coefficient of expansion of which is practically the same as that of the iron; thus the use of platinum is avoided. The iron leading-in wires, it will be observed, are thickened at the bottom, making two stubs which are quite stiff, upon which the contracts in the base bear.

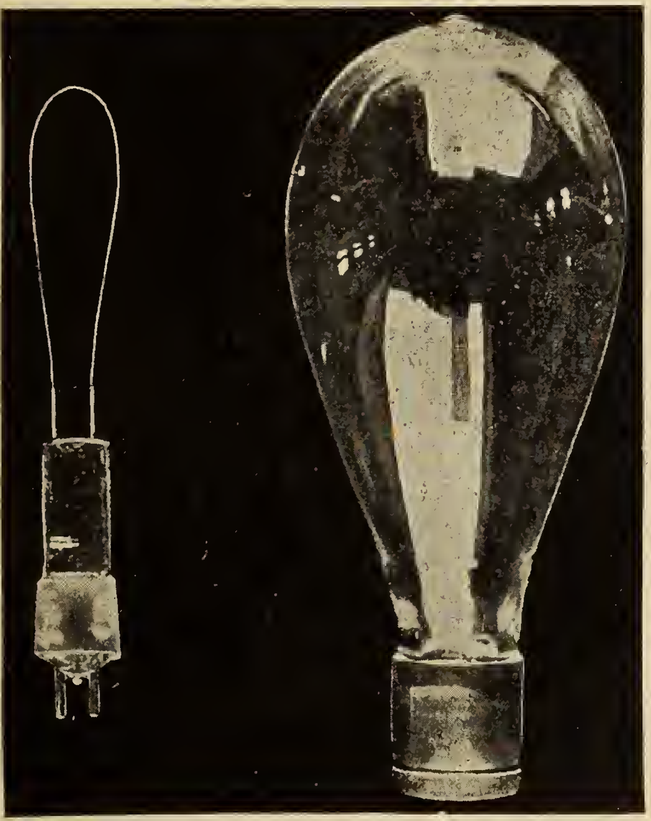
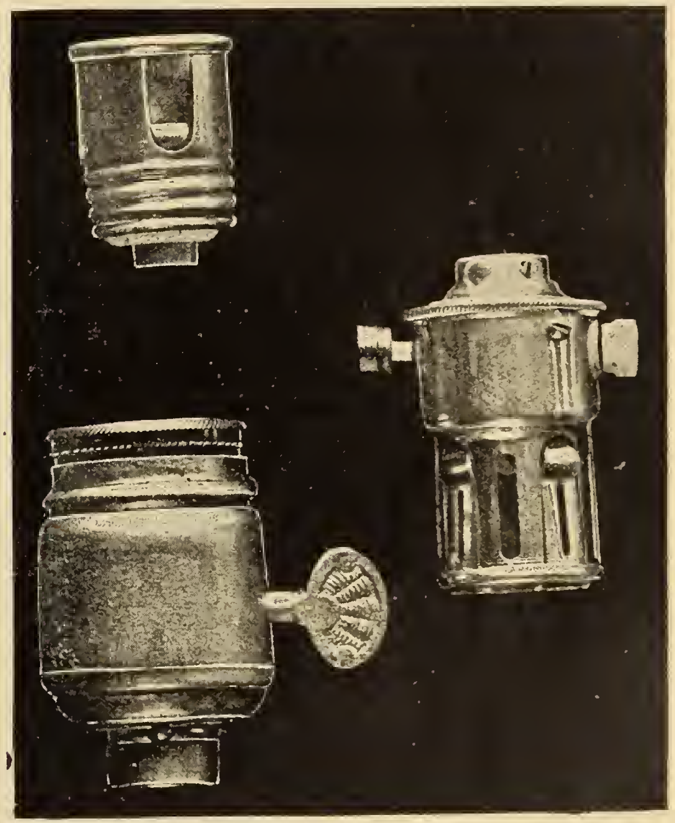


FIG. 1.—STOPPER AND BULB OF NEW WESTINGHOUSE LAMP.

The stopper is ground in a special machine and fits into the corresponding neck in the bulb of the lamp. When the stopper is inserted, a cement is applied which aids to maintain a perfect seal. When it becomes necessary to renew the filament, the stopper is removed, a new filament is attached to the leading-in wires, the stopper is re-inserted, and the lamp is again exhausted. This operation can be accomplished at a very small cost, and hence there ought to be no excuse for the continued use of blackened lamps.

During the exhausting of the lamps, the Westinghouse Company introduced nitrogen gas at intervals, for the displacement of the oxygen of the air, so that the residual atmosphere, when exhaustion has been carried to the last point, consists largely, if not entirely, of nitrogen.

As will be seen in Fig. 1, the lamp is complete in itself and can be readily adapted to any type of socket. The lamp is pushed into the base by which contacts are made into the leading-in wires; the base is then pushed into the socket, no screw motion being employed. Fig. 2 shows the base employed for use on Edison sockets.



FIGS. 2 AND 3.—SOCKETS FOR WESTINGHOUSE STOPPER LAMP.

A special and very simple form of pendant switch has also been designed for use with the lamp, as illustrated in Fig. 3. By merely pushing in the white or black button, the lamp is switched on or off, and this can be readily accomplished by the the use of one hand.—*Electrical Engineer.*

After spending several million dollars on their cable street railway, Philadelphia is about to abandon the system for that of the trolley.

In operating street railway plants by electricity generated by water-power, says *Engineering*, the excessive variations of load unavoidable in such service has rendered the problem of efficiency regulating the generating power an extremely perplexing one. The inertia and incompressibility of water render it impossible to control the flow with sufficient promptness to follow closely the sudden changes of load. In a street railway plant at Oswego, N. Y., this difficulty seems to have been met quite successfully by the use of an artificial resistance of iron wire of a capacity nearly equal to the maximum output of the generators. This makes a compensation which may be automatically varied so as to maintain a constant load on the generators, notwithstanding the fluctuations of the live load.

TORONTO NO. 1 C. A. S. E.

The Toronto Association No. 1 held its second open meeting this season in the Shaftesbury Hall, on Friday, the 10th ultimo, Mr. W. G. Blackgrove, the President, presiding.

Mr. George C. Robb, chief engineer of the Boiler Inspection & Insurance Co., delivered an interesting and practical lecture on "Boiler Explosions" which was greatly appreciated by the large number present. The speaker, in opening his remarks, stated that he was unable in any dictionary to find a good definition of the word "explosion." In one book it was defined as "a sudden bursting of noise" and in another place it was explained as being "a sudden expansion of a substance or an elastic fluid," but neither of these or other definitions in such books gave a technical meaning of the word.

Boiler explosions, he thought, could arise from one of four causes, but before dealing with these, he would like to speak of two reasons often given, but wrongly accounting for, these occurrences, viz: Electricity and gas from decomposition of water. As regards the first, that theory had been knocked on the head by the experiments of Prof. Faraday, which proved that electricity supposed to be in boilers was only produced by the friction of escaping steam and water, and was not inside the boiler at all. If anybody could prove electricity to exist in boilers, they could make their fortunes, as that would do away with the necessity of using steam engines and dynamos to produce electricity. As to the second erroneous reason commonly given, no gas would be found in a boiler that could bring about an explosion by itself. The question therefore was, what force produced these calamities? The lecturer considered it was the energy stored in the water, and the more water there was in the boiler, the greater and stronger was the explosion, although many still believed in the old idea, that if a boiler had enough water it could not explode. The energy in water at a temperature of 100 pounds pressure or 337° F. in falling to 100° F. has an escape of 237 units of heat from each, and a unit equals 772 pounds raised one foot. If all the energy stored in the water over 100° F., could be utilized, each pound of water would yield enough to lift 90 tons one foot high.

The speaker went on to show how this great force, once an opening was made for a commencement of its escape at any weak point in the boiler, would first rupture the parts of the boiler, and then, as it reached the outer air, would momentarily displace the pressure of the atmosphere. This displacement would be quickly followed by condensation of the escaped steam and a return of the atmospheric pressure. When the force suddenly escaping from an exploding boiler was thus considered, and the power of a return shock from the atmospheric pressure, taken into account, it was no wonder that such disastrous results were often produced by boiler explosions.

The four actual causes of boiler explosions were then considered.

1. Defective Construction—either from faulty design or bad workmanship. Defective staying of flat surfaces was alluded to as a common cause.
2. Corrosion, and consequent weakening of some part of the boiler, if the boiler was exposed to pressure.
3. Over-heating of Plates.—Low water or the presence of some form of deposit would cause over-heating. With many, low water was considered a fine explanation of nearly every boiler explosion. As a matter of fact, it was not a common cause. There was a general belief that if the plates became red hot and water was caused to flow over them, explosion would follow immediately. Experiments recently made in England with a large boiler, in which the plates over the surfaces were made red hot and water pumped on them, failed completely to produce explosion; the plates were injured and the joints leaked, but that was all.
4. Over-pressure, which was generally brought about by defective safety valves.

In support of these statements the lecturer referred to several cases that had come under his personal notice in Ontario, and explained clearly by means of sketches on a black-board the reasons of the several explosions he referred to. The prevention of explosions was next referred to. The necessity for careful attention to this matter was proved by the statement of the Hartford Steam Boiler Insurance Co., that in the United States during 1893 there were 269 boiler explosions, causing the death of 298 persons and injury to 442.

The speaker thought the first step was to be sure that the boiler was well made and the proper material used, designed so as to be strong enough for safety at the intended pressure. The boiler should be managed by a competent engineer who realized the dangers to be guarded against. Frequent and thorough examinations of the boiler should be made by some one in a position to judge of its condition. There is in England a law, which requires the user of every steam boiler to report every accident of the nature of an explosion, within twenty-four hours after its occurrence. Investigation follows, and the court, formed generally of two engineers and a lawyer, has power to punish whoever is proved to have been at fault. This act has worked well in England and, he thought, a similar one in Canada would be productive of good results.

At the close of the lecture several questions, put by the members of the Association, were answered and additional explanations given in regard to the points raised.

A vote of thanks to Mr. Robb, proposed by Mr. A. M. Wickens and seconded by Mr. G. C. Mooring, having been carried unanimously, the meeting was brought to a close.

TORONTO STREET RAILWAY COMPANY.

Rapid progress has been made with the new power house for the Toronto Street Railway Company, situated at the corner of Frederick and Front streets. The necessary alterations to the premises cost the large sum of $50,000, which includes $9,000 for the chimney shaft, which is 175 feet high and is said to be the tallest in Toronto. The twelve boilers with their furnaces are fixed; each has a diameter of 72 inches and is 18 feet long. They were built by the Polson Co., of Toronto. The smoke breeching to these was executed by Mr. John Abell, Toronto. It is of heavy boiler plate and is about the finest piece of work of its kind on this continent. The foundations to carry the engines took over a million and a half of bricks, and each has a base of solid concrete underground ten feet deep.

There will be four double cross compound engines and a a single one having an 18 inch stroke with 21 and 36 inch cylinder. These were made by Messrs. Armington & Sims, Providence, R. I. It is to be regretted that the company did not get this part of the work also done in Canada.

The Corliss cut-off allows for an expansion of the steam by means of five large gigantic condensers fixed in the basement; a vacuum will thus be caused at the end of every stroke. The supply from these condensers will come direct from the bay by means of a 30 inch main now being laid, and after cooling, the steam will be dischared into the sewer.

One of the engines is already fixed, and is expected to be in use very shortly. Ten carloads of machinery have arrived and by the beginning of June next the whole of the works will be completed, when we hope to give some further details and illustrations of what promises to be one of the finest power houses in America.

The company are also making extensive preparations for the coming season. They have already fifty-nine motor cars fully equipped. Forty-six cars are at present running on the streets. Sixty new open cars are in course of construction, and many old ones are being overhauled and repainted. A private car is being built for the directors, and is being fitted up regardless of expense. It will be somewhat larger than the new electric cars now running, and is a rare specimen of fine workmanship. A storehouse capable of sheltering 81 cars has been built on Yorkville Avenue. It is a brick structure 250 feet long and 100 feet wide; there are nine tracks running full length of the building, three of which are excavated underneath to allow workmen to carry out repairs to the tracks without removing the cars. There is also a complete blacksmith shop in the building.

PUBLICATIONS.

The literary features of the *The Arena* for February are a carefully prepared biographical sketch of the "Life, Character and work of Charles Darwin" by the editor. A second argument in favor of Shakespearean authorship by Dr. W. J. Rolfe, the eminent Shakespearean scholar. A story by the Canadian poet, William P. McKenzie, entitled "Was it Prophecy?" and a poem entitled "Tne Minority." This number is rich in able discussions of vital Social and Economic problems.

QUESTIONS AND ANSWERS.

"Young Engineer" asks :—

1st. How to work out indicator diagram ?

This question is not very explicit. The indicator diagram is worked out for so many different purposes, that a whole volume might be written on this subject. If "Young Engineer" merely wants to know how to work out the horse power, the following will help him : The diagram should be divided into ten equal divisions lengthways. In the middle of each of these divisions draw a line at right angles with the atmospheric line. Measure on each of these lines the number of pounds pressure between the steam line and the exhaust line of the diagram. Add the ten numbers together and divide by ten, and the result is the average pressure of steam on the piston available for work. Then multiply the area of the piston in square inches by the average pressure in pounds and by the number of feet the piston moves in one minute, and divide by 33,000, and the result is the horse power.

2nd. Is the pressure on the slide valves equal to the area of ports, or is the total surface of valve to be considered ?

If the valve is absolutely tight against the face on which it moves then the whole surface should be taken into account in estimating the pressure on the face. Very few valves are thus absolutely tight, and the area of ports covered by the valve will in most cases give more accurately the load when multiplied by the pressure of steam on the back of the valve. When making such a calculation the pressure on the other side of the valve must be taken into account, and if engine is a condensing one, the effect of the vacuum will add probably 12 lbs. per sq. inch to the pressure on an area equal to that of exhaust port.

3rd. Why will a long chimney give a fiercer draught than a a short one ?

The velocity of draught is due to the falling of a body of cold air from a height equal to that of the top of the chimney above the grate bars. It is a well known fact that the velocity of a falling body increases with the distance through which it falls. The draught of a chimney follows this same law, but allowance for friction and for weight of the air inside the chimney has to be made.

4th. In calm weather, the sun not shining, the temperature of boiler and furnace the same as atmosphere, is there a draught in furnace ?

This question implies so many hypothetical conditions that the best way to get an answer will be to go to a furnace when under the conditions stated and try whether or not there is a draught. In a general way it may be stated, however, that unless there be a difference of pressure there will be no draught, and the necessary difference of pressure is generally obtained by making a difference in temperature. If there is a higher temperature in the upper part of the chimney than in the furnace there will be a draught from the furnace and up the chimney.

Mr. T. J. Trapp, of New Westminster, B.C., requests through the ELECTRICAL NEWS, or any of its readers, information on the subject of the application of electricity to mining operations. We have in a measure complied with our correspondent's request, but would be pleased if our readers would supplement the information given by sending us contributions on the subject.

NOTES.

The trustees of the Montreal Association of the Canadian Association of Stationary Engineers are authorized to purchase a working model of a Corliss engine. This Association will on May 1st remove their quarters to the Oddfellows' Hall, Craig St.

At the weekly meeting of the Marine Engineers held in Shaftesbury Hall on March 1st, Mr. Crabtree exhibited a new valve regulating machine and explained its working. President S. A. Mills presided. The society appears to be prospering ; several new members were elected at this meeting, and steps are being taken to amalgamate all the lodges. A report was also read to the effect that another branch of the Association had been formed at Halifax.

It is a matter of continual and increasing surprise to us, that any boiler maker of repute should be willing to send out boilers of over 30 inches in diameter, without the fullest provisions for gaining access to the interior. Corrosion, pitting, grooving, deposit of scale—these and many other defects can be detected and satisfactorily observed only by direct observation of the inner surfaces ; and when a boiler is large enough to admit a man, it should always be provided with a manhole. To omit such an important opening is highly dangerous.—*The Locomotive.*

TESTING ARC CIRCUITS.

The following device, for locating faults, such as leaks, grounds, crosses, etc., and for determining the number of lamps burning on a circuit, says A. H. Manwaring, in the *Electrical World* may be of interest to central station managers. It consists of a series of resistances, as, for instance, a bank of sixty incandescent lamps of high voltage, and a switch arranged to cut off circuit one incandescent lamp after the other, a double contact grounding switch, an automatic switch to protect the incandescent lamps from accidental swinging grounds, etc., and a special indicator to determine the number of lamps desired.

In making a test, the first operation is to determine how many arc lamps are burning on the circuit. This is done by connecting the two flexible cables (that are attached to the test board) one to the positive and one to the nagative side of the circuit to be tested. This connects all the sixty incandescent lamps in series as a shunt to the main or arc circuit; then the incandescent lamps are cut out of circuit, one by one, with the centre switch shown in the cut, until the indicator needle reaches the standard mark on the scale. The number of incandescent lamps remaining in circuit is equivalent to the number of arc lamps burning on the main circuit. After having determined the number of lamps burning, the operator moves the grounding switch—marked P—which disconnects the negative side of the test board from the main circuit and connects it to ground. The test is then made the same as before, by cutting out the incandescent lamps, and if a ground exists the indicator needle is brought up to the standard mark on the scale, and the number of incandescent lamps remaining in circuit is equivalent to the number of arc lamps on the positive wire between the dynamo and the ground.

To determine the number of arc lamps on the negative side of the main circuit between the dynamo and the ground, the operator reverses the grounding switch and repeats the test. If the number of lamps on the positive side and those on the negative side to ground do not equal the number of lamps indicated on the first test, the ground is not a perfect one, but offers a resistance, and the difference should be added equal to the number of lamps on each side, to locate the ground accurately. Thus, if he gets 40 lamps across on first test, 20 lamps P. second test, and only 10 lamps N. on third test, he adds 5 to each of the positive and negative sides, locating the ground between the 25th and 29th lamps of the positive side of the circuit. A ground on underground cable is located in the same way as on an air line, between two lamps.

A swinging ground is located by cutting out of circuit only a few of the incandescent lamps at a time, and watching the deflection of the needle when the ground swings on, continuing to cut out the incandescent lamps until the swing of the needle reaches the standard mark on the scale.

To locate a cross between two different circuits, first see that both circuits are free from a ground connection ; then substitute a ground on one, and measure the other circuit, and the cross can be located. If a ground should exist on one circuit, it is not necessary to add another.

If in making a ground test where two or more circuits are run on the same dynamo and the needle of the indicator is deflected in the opposite direction from other tests, it denotes that the circuit under test is clear, and that one of the other circuits is grounded ; or if the number of lamps on ground tests exceeds those across the circuit on first test, it indicates that the ground is on one of the other circuits.

To determine if the current is reversed in a circuit, connect the flexible cables to the circuit marked, P to P and N to N. The needle should be deflected to the right if the current in the circuit is travelling in the proper direction, but if it is diverted to the left it denotes that the current is reversed.

A high voltage lamp is prepared so that the carbon only becomes red, thus making the test-board a high resistance through which it is perfectly safe to ground a circuit. By this arrangement only one-fifth of an ampere is shunted to ground when testing a grounded circuit.

This device, it is found, saves a great amount of time in locating trouble, and a man can be sent direct from the station to repair the same ; it also lessens the danger from accidents and fires caused by unknown grounded circuits, as circuits can be tested as often as desired and trouble removed in a short time. This testing device is already in use in several central stations.

POWER TRANSMISSION FOR CENTRAL STATIONS.*

By Louis Bell.

So far as distribution is concerned, we may divide electrical power transmission into three classes: first, the transmission of single units; second, the transmission of power to a centre of supply, from which point it is to be distributed in various ways; third, supply the power for lights and motors throughout the length of the transmission line. Each of these classes of work imposes conditions on the possible methods of transmission, and requires special consideration. In new plants, hampered in no wise by existing stations, any one of these three cases may exist, perhaps the last two more frequently than the first. Where a single motor is to be employed, the problem is exceedingly straightforward. Where a new centre of distribution is to be organized, some complications are encountered, but not serious ones. Where power is to be scattered along the line, however, conditions arise which are not altogether easy of fulfillment and require a good deal of special care and skillful engineering. In a general investigation of the methods which may be employed, the case stands somewhat as follows, so far as the central station man is concerned:

First, if the distance over which he is to transmit power is moderate, he may use the ordinary direct current generator and motor, displace his engine with the motor and go ahead. But unfortunately, direct current machines of any considerable capacity are practically limited in voltage by the existence of the commutator, an article on which central station men in general waste no love. Dynamos and motors of large size cannot, individually, in the present state of art, be satisfactorily built for more than about 1,200 volts. Machines for greater voltage have very generally broken down in the experimental stage. For very small power units, arc machines might be employed, but for the purpose of the central station man, it is better to move his arc machines directly to the distant point. For voltages much in excess of that mentioned, we are then driven to the use of either direct current machines in series or alternating machines.

Where generators and motors are to be used as a single unit, direct current machines in series may be and are employed quite successfully, but as the voltage desirable on the line rises, the system contains a greater number of units and becomes more complicated and difficult to apply to central station practice. For instance, it is highly desirable for the successful operation of motors in series that they should be, practically, coupled to the same shaft, and should run under similar and uniform conditions, so while there are cases in which the method of coupling in series may be both convenient and cheap, it is in my opinion better general practice to employ alternating currents, after passing the ordinary limitations of direct currents.

Here we encounter a complicated state of affairs, for the central station man who attempts to investigate the subject is immediately surrounded by a cloud of mental dust, through which he sees dimly the outlines of plain alternators, bi-phase, tri-phase, and multi-phase generators and motors, condensers, Geissler tubes, six-foot fuses, electrified wall paper and the other properties of a well equipped modern high voltage electrician. The substance of the matter, however, is something as follows:

We want to use power transmission by alternating currents for two good and separate reasons: first, because we get rid of the commutator and can therefore use as high voltages as we can safely insulate in the machine; second, because by the use of transformers, we can obtain for the transmission line itself any voltage which we can insulate, and thereby enormously decrease the cost of the copper which must be stowed away as permanent investment in our line.

Multiphase currents, and by this I mean currents having more than one phase, are subject to the same general laws as any other alternating currents. Their most valuable peculiarity lies in the fact that for alternating currents of more than one phase excellent motors can be built which will run at a steady speed, start under heavy load, and in general possess very much the same qualities as a well organized shunt motor of the ordinary kind. Incidentally, certain of the multiphase systems, more especially the three-phase, enjoy the advantage of effecting something of a saving in copper, under favorable circumstances up to 25 per cent. from what would be required by a plain alternating current of the same nominal voltage. This saving is merely from the fact that in the three phase line, the currents do not have their highest value at the same time, so that at any particular instant two of the wires may serve as a sort of multiple return for the third. This advantage would be immediately thrown away, if for the three currents of different phase three separate pairs of wire were employed, as it is thrown away where for two currents of different phase two independent circuits are used.

The fundamental difference between single and multiphase systems, then, is mainly the adaptability of the latter for driving motors, and multiphase are better than single phase motors principally in their ability to start under load, and somewhat larger output for the same weight.

Wherever, then, single motors are to be driven for operating, we will say, an electric light station, it is largely a matter of convenience whether we employ single or multiphase motors. If the former can be conveniently started, they are fully competent to take care of the work, except in one special case which I will mention presently. The multiphase motors, whether synchronous or otherwise, start very freely, and may or may not be economical in cost of copper, according to the arrangements of the circuits.

A single case in which multiphase transmission becomes of great importance when the object is to work an existing central station is in that case where railway circuits are to be supplied. A railway machine is subject to so great and violent variations of load, that if it were driven by an ordinary synchronous alternating motor, the latter would run great risk of being pulled out of phase by a sudden short circuit, when it would stop and stay stopped until deliberately started up again. The multiphase motor can also be pulled out of phase, but not quite so easily, and it can be more readily started. We can, however, where railway currents are necessary, do much better than to drive the dynamos directly by motors of any kind. We can for this use start with the multiphase current, and through the medium of a single machine, scarcely more complicated than an ordinary railroad dynamo, transmute this multiphase current into a direct 500 volt current of the ordinary sort. This very valuable result has been brought about through the ingenuity of C. S. Bradley, who invented the device half a dozen years ago. It has remained dormant, principally because there has been no special call for power transmission of any kind until recently, but to its thorough practicability I can personally testify, as a 100 kilowatt tri-phase direct current transformer which I recently tested, operated in the manner described, showed an efficiency of over 95 per cent. at full load, stood sudden variations from no output up to 100 kilowatts and back again without even a wink at the brushes, and bore up under heavy load without difficulty. Whenever it is desirable to operate railway circuits by power derived from a distant source, these machines fulfill the practical requirements, and I believe are destined to come into very extensive use, and play an important part in the development of very long electric railroads.

To sum up this point, where single motors are to be employed for driving other electrical machinery, either synchronous, alternating or multiphase motors can be successfully employed. Where railway dynamos form a part of the load, a particularly good result can be obtained by using for this particular portion of the work the multiphase direct current transformers.

So much for the operation of existing plants by electrical transmission of power, where it is merely intended to substitute a motor or motors for an engine.

Now, take up a case where the centre of distribution is to be fed, consisting it may be in part of an existing station and in part either of extensions and new circuits from this plant and subsidiary centres of distribution having other districts of the same town. Here the problem becomes more complicated and it is almost impossible to lay down any general procedure. Each case is best handled by itself. We can, however, enunciate certain principles which will aid in the discussion of any definite case.

First, we can feed all existing railway circuits and extensions very effectively and economically by use of the tri-phase direct current transformer just described.

Second, we can handle all direct current incandescent systems, whether two or three wire, by means of the same type of apparatus, the tri-phase direct current transformers.

Third, we can successfully operate any existing alternating incandescent circuits or any extensions thereof by feeding alternating current from the distant point directly into them through banks of transformers.

Fourth, if any new centres of distribution are to be made with circuits independent of those already in existence, we can operate these circuits very effectively for both lighting and motor service, if both be necessary, by employing multiphase apparatus; and right here let me say that there is one widely spread error which I desire most emphatically to contradict.

It has been asserted that incandescent lighting cannot be successfully done on multiphase systems, especially tri-phase, since this system happens to have been most talked about. This statement is absolutely false, to my own personal experimental knowledge. Lamps can be as successfully operated on systems of two, three or more phases as on an ordinary single phase circuit, provided equal pains be taken with the distribution of copper in the lines and the regulation of the voltage at the dynamos. If these conditions are observed, a two-phase circuit with separate wires acts substantially as if fed from two ordinary alternating dynamos. A tri-phase circuit gives a similar result, and if more phases were concerned, the same would be true. If the condition of constant voltage at the centre of distribution be fulfilled, as it can be and must be for successful operation on any system whatever, two and three phase incandescent lighting systems can and do work admirably. Furthermore, if we combine circuits, for example, if we use but three wires instead of six for the three phase system, there is no exact equality of balance required between the lamps placed in different connections across these circuits. On the three.phase system we would place between each possible pair of the three wires this arrangement, gaining in copper wire enough to compensate for the slight inconvenience in connecting three sets of lamps instead of one or two. Branches can be run from any two wires of the tri-phase arrangement, and lights placed on them will act exactly as if they were placed on any ordinary alternating circuit. With such an arrangement you should be able to throw off all the lights on one side of the circuit, without producing any noticeable variation in the lights of the other two branches; no more variation, for example, than you would get, if on a given set of secondary mains from a common transformer, you were to turn off or turn on one-third of the total number of lights. If any man comes to me and says that a three-phase system will not run lamps successfully unless there is careful balance between the lights on different sides of the circuit, I have in that statement sufficient evidence to convict him either of ignorance of the principles of wiring and dynamo regulation or of wilful misrepresentation of the facts. I lay stress upon this matter of incandescent lighting in defence of multiphase systems, because it is the one upon which they have been most often misrepresented, chiefly through foreign experiments, which I do not hesitate to denounce as clumsily conducted.

In taking up the condition I have just mentioned—that of new centres of distribution—I may briefly refer to the properties of multiphase motors, which have been the subject of all sorts of misstatements. A multiphase motor, I do not care whether it has two or more phases, should if properly built have very nearly the properties of a good shunt motor, and not far from the same efficiency. Incidentally it has the advantage of having no commutator and no necessity for any moving contacts. It starts under two, three or more times the running torque, just as a shunt motor does, and by virtue, if the torque is extreme, of a heavy starting current; just as a shunt motor would. It comes rapidly up to nearly fixed speed, and remains nearly at that speed under variations of load. If overloaded it stops, like any other motor. In addition, it has one great merit that shunt motors do not have, that of running at nearly constant speed independent both of load and moderate variations in voltage. It is on the whole less thin-skinned than a shunt motor. I have experimented with a considerable number of multiphase motors of the induction type, to which I here especially refer, and although I have seen some terribly severe tests in the way of overload, I never yet saw any symptoms of a burn-out. The efficiency of these machines should be and is at least within one or two per cent. of ordinary shunt motors.

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* Read before the National Electric Light Association, St. Louis, March 1, 893.

There has been much discussion as to the relative merits of two and three-phase induction motors. In general the more phases the smoother action of the machines in various respects. I have never yet seen a two-phase motor any better than a three-phase motor. I should want a pretty careful series of tests to convince me that I have seen one as good. The difference between them with proper design, ought not to be very great, though the three-phase has the advantage in cost of wire. There are two important points in which multiphase motors have been misrepresented, which I shall mention:

First, it has been said of them that they take an enormous current when running light, and second, that they introduce a very large and most objectionable lag in the circuit, so that the apparent current on the line is much greater than the energy current. Such facts have doubtless been observed. Broadly speaking they have been due to faulty design. A multiphase motor will always take a somewhat larger current when running idle than the corresponding direct current motor, but it takes very little more energy, as the phenomenon of lag then becomes noticeable, so that of the apparent current running light only a portion represents energy. It is a perfectly simple matter to cut down the current required by a multiphase motor running idle to twenty or twenty-five per cent. of the full load current, still retaining a motor excellent in its other properties. As motors where power is sold by meter are usually cut oft when not needed, the whole system of this idle current sinks into insignificance. The same is true of the alleged lagging current. If a multiphase motor (I speak with certainty at least regarding the three-phase) of 10 or 15 horse power should show at full load more than 10 or 12 per cent. of lagging current, I should consider it to be badly designed, so that these two questions of so-called idle current and lagging current as distributing factors in a multiphase line can be and are reduced by proper care in designing to comparatively insignificant quantities. It has been very ingeniously suggested to give them a further shove down into oblivion by means of condensers, but it is a commercial rather than an electrical question as to whether leakage current and lag had be thrown quite into the abyss by the added complexity of condensers or left hanging on the ragged edge without them.

In case, then, of working a central station from a distant water power where necessity for extensions or new centres of distribution exists, we have plenty of methods available: Tri-phase direct current transformers for railway and direct current lighting service, alternators to feed into the existing mains or to supply extensions for them and for new centres where light alone is to be employed, ordinary alternating currents, or where both light and power are necessary, multiphase apparatus which, as I have shown, is entirely applicable for such a mixed system.

I may add that there is a possibility that we may have before long practical motors to run on an ordinary alternating circuit constructed after such methods as were suggested by Prof. Thomson a few years ago. In very small sizes they are already practicable. Brown, abroad, has been making a desperate effort to exploit these very methods on his own responsibility and has obtained motors which run successfully but as yet do not start well under load. From what I can learn of them, I doubt very much if they are any improvement on the motors of the same type shown by Prof. Thomson at the Paris Exhibition or on Mr. Tesla's motors for running on a two-wire circuit.

Whatever the methods which may be employed, several serious questions must be confronted when one attempts to transmit power for supplying central station or any other apparatus. One of these which presents itself immediately is whether or not in an alternating transmission it is advisable to use step-up and step-down transformers. The principal determining factor in this is cost. The higher voltage we can supply direct from the machine without increasing its cost considerably, the cheaper we can make the installation. Unfortunately in building dynamos, the armature coils have to be insulated, and where the voltage is very high, the insulation is correspondingly thick, so that with a given amount of material, we must in building a high voltage machine take up with insulation the space which would otherwise be available for copper. The result is that a dynamo wound for 4,000 or 5,000 volts is intrinsically more expensive, unless the size be very large, than a machine would be for 1,000 or 2,000 volts, besides being considerably less reliable. Machines of such voltages as these have been built in this country and abroad and some of them have given very fair results, but they are expensive to manufacture, at whatever prices they may have been sold in individual instances, and it is my personal opinion that where it is necessary on the score of economy to raise the voltage as high as 4,000 or 5,000 volts, it is better and cheaper, unless the units be very large to use step-up transformers and carry the voltage up to 10,000. Assuming 2,000 or 3,000 volts as the available potential obtained from the machine direct and then estimating the cost of a given installation, first using these machines and second using the low voltage machines with step-up transformers, we find that at prices ordinarily charged for apparatus and copper, the two methods become of equal cost at a distance of somewhere about seven or eight miles. Above these distances, the step-up transformers cheapen the plant; below it, they increase the expense. We can draw the line at no specified given distance in the general case, but can very easily for any specified case.

The amount of drop advisable in these long distance lines will depend of course principally upon the relative prices for copper and the apparatus necessary. If copper be relatively cheap, it pays to employ a good deal of it. If apparatus is relatively cheap, it is better to use larger generators and allow more drop on the line; 15 to 20 per cent. will hit the large majority of cases on the score of economy and convenience. It should be remembered, however, that for such drops as these good regulation is most essential, but good enough is available with direct, alternating or multiphase machines, to make these drops thoroughly practicable. The approximate figures I have just given on the limitations of the step-up transformer and on drop are the result of the investigation of a large number of concrete cases which I have had occasion recently to examine in detail, and for a number of which the apparatus is now in process of manufacture. I therefore feel personally convinced of their practicability, both theoretically and otherwise.

But for the central station man who desires to decrease his operating expenses by the employment of electrical transmission the court of last resort is the balance sheet and the fundamental question is, "Agreed that it is practicable, will it pay?" I can give no general answer to this question, for each problem necessarily must be considered by itself. It is possible to formulate equations which will connect all the variable factors of cost and annual charges, so as to enable one to derive from them an answer to this all important question. But the character of such formulæ is necessarily so complex and involves so many quantities that it is generally easier to take a short cut to the result by making a few approximate estimates. I have, however, looked into the profit and loss probabilities of a large number of plants of all description and in a general way one can say that power transmission to a central station will, unless the cost of developing the water power be very great, almost universally pay at distances of 10 or 12 miles or less. It will frequently pay up to 20 or 25 miles; now and then, under extraordinary conditions (very expensive coal and very cheap water power), up to 40 or possibly even 50 miles. In using alternating currents at these long distances one naturally fears the effects of inductance in the lines and of static capacity. In very long lines, operated at high frequency, these difficulties may rise to formidable magnitudes. Knowing the dimensions of the line, the frequency and the currents, it is, however, possible to calculate the effects of these distributing elements with great accuracy. From these calculations I feel safe in saying that within the distances mentioned inductance and static capacity constitute no serious obstacles to success, if the frequency employed be moderate; such, in other words, as one would be led to select in considering the operation of motors alone. Large generators are as readily and nearly as cheaply built for frequency of 50 or 60 as for higher ones; sometimes more easily under these circumstances. I think cases would be rare where transmissions, the advisability of which would be dictated by commercial consideration, would encounter serious difficulty from inductance and capacity. I have never personally investigated a proposed transmission of over 50 miles that gave any promise whatever of financial success, but the time may come when such a case will appear, and if it does, the work can be done successfully so far as the electrical part of the matter is concerned. I think the greatest difficulty in surmounting long distances is the difficulty of keeping a long line in proper repair.

Throughout this discussion I have take the position that no one method of procedure is applicable to all cases. Personally I am decidedly eclectic in my taste, believing that it is better to put in for each individual case such apparatus as on the whole proves to be cheapest and best rather than to advocate, on any fine drawn theories, methods which might be applied to the perfectly general case of transmission of power. It is the concrete rather than the abstract that we have to consider when proposing apparatus on which the success of large commercial affairs depends, and although some methods are better than others, it is well to remember that while the electrical pharmacopœa may have its calomel and paregoric it contains no elixir of life.

The ten electric machines for the compilation of statistics used by the Dominion Government cost $625 per month for their operation, but they are declared to be more accurate than other methods.

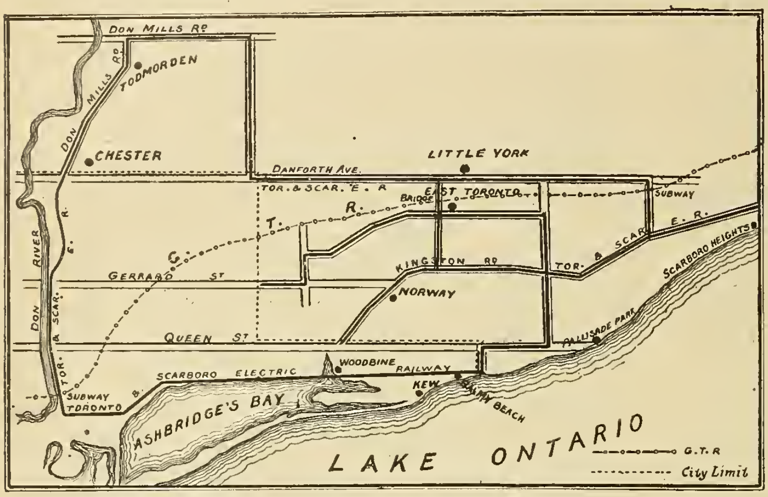
A convention of the Telegraphers' Association of North America will be held in Toronto on the third Monday in May. It is expected 500 delegates will be present. The City Council have already arranged to extend the visitors several courtesies.

Applications for the street railway franchise of Peterboro', have been made by three companies, viz.: Messrs. Ahearn and Soper of Ottawa, the Canadian General Electric Company, and the Peterboro' & Ashburnham Company. The Town Council have given their decision in favor of the Canadian General Electric Company, and a franchise has been granted to that company for twenty years from July 1st.

THE TORONTO AND SCARBORO' ELECTRIC RAILWAY.

Rapid transit is an absolute necessity for a growing city and its suburbs. It is therefore not surprising to find that there are several enterprises on foot in different outlying districts of Toronto with the object of providing electric railways for these locations.

In our present issue we show a diagram of the proposed route and illustrations of scenery on the line of the Toronto and Scarboro' Electric Railway, the construction of which will be started as soon as the frost is out of the ground. When completed there will be from 15 to 20 miles of road, connecting East Toronto, Little York, Todmorden, Chester, Norway, Scarboro' Heights and the summer resorts in that locality with the city. Thus a belt line will be provided in the east similar to the one in the west of Toronto belonging to the G. T. R.



Proposed Route of the Toronto and Scarboro Electric Railway.

It is expected that the first section of the road along the Kingston road, Blantyre ave. and Queen street will be in operation by June. The line will not only be devoted to passenger traffic, but purposes doing also a local freight business, which no doubt will prove a great benefit to the locality, as the line will bring the district into connection with the city cars and the railways.

The line promises to open up the country and encourage industries to the locality, while the picturesque scenery of the neighborhood through which the line passes will no doubt be the means of establishing many summer residences, and make the district a favorite spot in the excursion season. We hope later on to refer to the appliances and working of the line.

ELECTRICAL TERMS.

At the present time electricity depends upon steam engineering for its generation. Therefore it behooves every live engineer to acquire all the knowledge regarding its generation and application that he possibly can. At the present time nearly all our ocean, river, and lake steamers are equipped with dynamos for electric lighting, and the engineer who does not acquire knowledge necessary to care for the dynamos and its appliances will find it hard work to procure a position. Engineers will find herein the electrical terms so clearly defined that any person can easily understand them: Volt, unit of pressure, called electro motive force, same as pounds of steam; ampere, unit of quantity, called current, same as gallons of water; ohm, unit of resistance, similar to friction; watt, unit of energy consumed, similar to foot pounds, and thus 746 watts equal one horse power, same as 33,000 foot pounds.

The whole question of electrical distribution may be popularly illustrated by its analogy to hydraulics. The dynamo is essentially a rotary pump, but pumping electricity instead of water.

If the discharge pipe of a rotary pump be carried around through a given circuit and connected with a suction, both pump and pipes being full of water, the movement of the pump will obviously cause the water to flow in one direction, producing a continuous current of water. Subsitute dynamo for pump, wire for pipe, and electricity for water, and conception of electrical transmission by the continuous current is at once clear as to its elementary phenomena. We will bracket the analogous electrical terms; then we may say that a certain number of pounds (volts) or pressure are required to overcome the friction (resistance) of the pipe (wire) in order that the water (current) may flow at the rate of so many gallons (amperes) per minute. The larger pipe (wire) the more water (current) can be carried and the less will be the friction (resistance) or per contra, the smaller the pipe (wire) the less the quantity (amperes) per minute and the greater the friction (resistance). Manifestly the pipe (wire) might be so small that the friction (resistance) would absorb a very large proportion of the power of the pump (dynamo), leaving but little remaining for useful effect, therefore the two horns of the dilemma are: if the pipe (wire) be too large, it will cost too much; if too small the loss will be too great.

The electrical appliances are also analogous to engineering appliances. The switches are valves, the fusible strips are the safety valves, the contacts are the pipe fittings. If the contact is insufficient to carry the current, there will be a leak (drop) in the current. The voltmeter is the pressure gauge; the ammeter is the same as the water or the gas meter, the recorder of the quantity consumed.—R. G. Davis, in *Marine Review*.

SOME POINTS ON ENGINE REPAIRING.

By C. H. Richards and V. L. Stockston.

The engineer not having much experience, is often at a loss to know just what to do in case of his engine wearing, and it happens not infrequently that when some repairs are necessary neither the engineer nor the machinist who is to do the work knows how to do it.

It is always well—in fact it is the duty of an engineer that can not be neglected except at much cost and possibly accidents—to look carefully to lubrication and keeping set-screws and keys properly tightened and an eye generally upon every part of the plant. The cups should all be kept feeding nicely, the crank-pin brasses and cross-head should be frequently examined and felt of to see that they are not too warm. The valves should be examined frequently—also the piston and cylinder. Unless this is done, trouble may arise and get far advanced before noticed in the working. This should be done once a month in any case.

Along the line of the Toronto and Scarboro Electric Railway.
A stretch of sand beach.

Therefore we send to the editor of the *Scientific Machinist* some hints to repairers of engines, and the engineer can often act as such himself, especially when the difficulty has not become serious.

When the valve faces wear, or become abraded, we recommend that they be filed crosswise of the cut. It will be found that they will then wear down evenly and make a good seat. A part of the seat, as every engineer knows, is never uncovered, and is very difficult to lubricate on that account. We have for years cut grooves in this valve face, almost but not quite through, about one inch apart. This lets in the steam and the seats become lubricated. There are some builders making their valves this way now. They should all be made so.

The piston and cylinder quite often get scratched and cut. The priming of the boiler will carry grit and sediment into the cylinder and it may get there in other ways. When the rings become cut, take them off and file, as before stated, across and not with scratches. When replaced, make a nice bearing. Many make them too tight. They had better be too loose than too tight.

ALONG THE LINE OF THE TORONTO AND SCARBORO ELECTRIC RAILWAY.
THE PALISADES (SCARBORO).

The rod will cut if the packing is left in too long, or if the glands are not properly tightened. When this occurs, scrape the scratch, lengthwise of, or with it. If no scraper is at hand, use a file, but be careful to do a neat job. Be sure and repack and see that the glands are right—neither too loose nor too tight—and do not bear on the rod.—*Scientific Machinist.*

LEGAL DECISIONS.

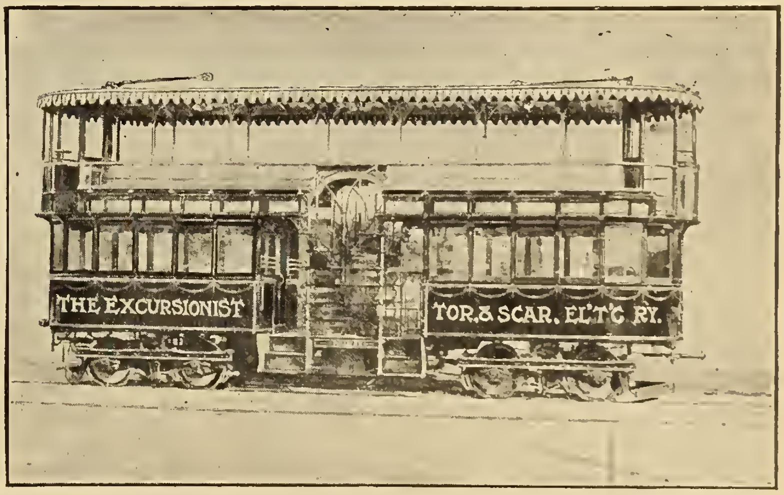
In an action of the Kerr Engine Co. against the French River Tug Co. the plaintiffs claimed $1,350 balance of contract and $428 extras. The contract was for putting engine and boiler in a tug of the defendants. The price agreed upon was $7,400, and the work was to be done by 18th April, 1892. the plaintiffs undertaking to pay $20 per day as liquidated damages for every day's delay after that date. The work was not completed until about 18th June. The defendants paid $750 into court, asserting as a set off $1,200 for the delay. The court only allowed 14 days delay to the defendants, as they held the defendants were responsible for the rest. In an appeal the plaintiffs were allowed the money paid into court, but had to pay costs of the actions.

Armstrong vs. Toronto Street Railway Company.—Judgment on appeal by the plaintiff from an order of Galt, C. J., in Chambers, reversing an order of Winchester, Master, directing production by the defendants of a report made by the driver of the car on which the accident happened to the assistant superintendent of the defendants' railway regarding the accident, in respect of which the plaintiff claims damages. The defendants claimed privilege on the ground that the report in question was made in view of impending litigation; but on examination for discovery their manager agreed to allow inspection of the report provided that the names therein mentioned of witnesses of the accident were kept covered. This offer being declined, production was refused. On this motion the plaintiff contended that there had been no production of the report; that no such privilege as that claimed could be relied on by the defendants, inasmuch as the report had been made in April, 1891, and no claim for compensation was made by the plaintiff till September of that year; and that no case had been made by the defendants for withholding discovery of the names of persons mentioned in the report, as it was not sworn that they would be called at the trial. Order appealed from affirmed, with costs to the defendants in any event.

The Supreme Court of Pennsylvania held, in the recent case of Smith vs. Western Union Telegraph Company, reported in the supplement to the Philadelphia Legal Intelligencer, that in a case of unintentional delay in the delivery of money by a telegraph company, because of which the plaintiffs note was protested, there could be no recovery for a mere loss of credit by reason of the protest, and that the rule in the case of the refusal of a bank to pay a customer's check where his deposit was sufficient to meet it did not apply. The court said: "It is true that in an action for the breach of a contract to pay money for a special object, which was known to the party agreeing to make the payment, damages directly and naturally resulting from the breach, and therefore supposed to have been in contemplation of the parties, may be given in addition to interest, but such damages must be shown by the evidence. It is also true that a bank which refuses to pay the check of its customer when his deposit is sufficient to meet it may be held for substantial, without proof of special damages. Patterson vs. Marine National Bank, 130 Pa., 419. It is contended by the appellee that the case at bar falls within the principle of the case cited, but we think there is a broad and substantial distinction between them. The powers, privileges and duties of a bank and its relations to the business transactions of the commercial world are essentially different from those of a telegraph company. Banking institutions are indespensable agencies in these transactions, and it is a wise policy which extracts from them fidelity to and a prompt performance of their agreements with their depositors. A bank's refusal to pay on demand the check of its depositor who has a sufficient fund with it for that purpose is not like the unintentional delay of an individual or a corporation in the fulfillment of a contract to pay the debt of another, and a measure of damages appropriate to the first is not necessarily applicable to the second-"

TELEGRAPHING WITHOUT WIRE.

Since June last constant electric communication has been maintained between the Needles lighthouse, England, and the shore without any direct metallic connections. An ordinary submarine cable has been laid in Alum Bay to within sixty yards of the Needles Rock, where it terminates with its copper conductor attached to a small anchor. This anchor is five and a half fathoms at dead low water. The shore end of the cable is attached to the signalling instrument: while to establish a circuit a simple earth plate is immersed in the water close to the shore on the lighthouse rock. Two strong bare wires dip into the sea about ten yards apart, which are in connection with the signalling instruments in the lighthouse. Thus through the intervening space of sixty yards the men on the rock can call the attention of those on shore or vice versa by means of an electric bell, and communication can be established by means of a single Leclanche battery cell.



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CHAS. H. MORTIMER,

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Correspondence is invited upon all topics coming legitimately within the scope of this journal.

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IN "Pickwick Abroad" we find the following given as a stoker's explanation of the steam engine: "This 'ere furnace, gen'lmen, heats that 'ere water, and that 'ere water is in this 'ere biler; and that there pistern rod is moved up and down by the steam from this 'ere biler; and them 'ere pisterns acts upon them rods, which turns the axles of the paddles, and the paddles their selves in consequence."

TELEPHONIC communication between Boston and Chicago, a distance of 1,200 miles, was established during the past month. The line is constructed of two No. 8 hard drawn copper wires, which weigh 435 pounds to the mile, and the whole circuit contains 1,044,000 pounds of copper. A circuit of the weight generally used would only weigh 413,000 pounds. There were 54,000 poles used with an average of 45 to a mile.

THE advisability of inaugurating a special cheap service between the hours of 12 and 2 o'clock for the accommodation of business men who might desire to lunch at home with their families, is worthy of consideration by managers of city electric street railroads. It is partially for want of such a service that down town lunch counters have of late done such a thriving business. It is a question worth considering whether some of their profits might not be directed into the pockets of the street railroad companies.

IT is surprising that riders of bicyles persist in running their machines on the car tracks in front of trolley cars. The dangers from this foolhardy practice are great; in the case of a mishap, such as the wheel catching in the rail or the machine colliding with a vehicle crossing the tracks at a crossing, the cyclist is left a poor chance of escaping with his life. Many, if not all, the sad calamities that have happened to people from the electric cars in Toronto have been the result of thoughtlessness and carelessness, and the practice complained of may have to answer for many more.

IN one of the earlier issues of the ELECTRICAL NEWS we referred to the electric railway constructed to carry passengers from Strachan Ave. to the Toronto Industrial Exhibition grounds, as being one of the first attempts at electric car propulsion on this continent. We observe that a gentleman residing near Fort Erie, is said to have recently purchased the train which was used on this line. We are not informed what his purpose is with regard to it, but we may express the hope that it will be preserved an an interesting memento of the beginning of things in the field of electric railway development.

DRY sand is used to a considerable extent on electric street railroad lines for the purpose of increasing the traction and enabling the cars to surmount heavy grades. In Toronto the conductor on lines where such grades exist keeps a pail of sand at his side and throws it in handfuls upon the rails as required. This antiquated method seems to be so entirely out of keeping with everything else electrical, that we hope soon to see it abolished in favor of some mechanical device which will perform the duty automatically, and allow the driver to give his undivided attention to the brake and rheostat.

THE accumulation of snow and ice on the streets of Toronto has been greater during the winter which is about to close, than for many years previously. This coupled with the fact that the company had barely time to get some of its lines into running order when winter set in, placed them at a serious disadvantage so far as preparation for keeping their tracks clear and maintaining an efficient service are concerned. Many of the citizens, appreciating the unusual difficulties against which the company have had to contend, have been both greatly pleased and astonished at the energy and skillful management by means of which a first class service has been provided throughout the winter. It is safe to say that more serious difficulties are never likely to be met with in the future operation of the system.

THE opening of the overhead electric railway at Liverpool docks by the Marquis of Salisbury, on the 4th ult., is an interesting event to the electrical world, marking the first instance in which electricity has taken the place of steam for overhead locomotion. While there can be no objection to the use of electricity on overhead roads there are certainly many advantages. The cars can move without the noisy accompaniment of an engine, the atmosphere will be free from fumes from a furnace, and the thoroughfares below the track will be clear of showers of cinders. The cost of the new line, including equipment, was about $450,000 per mile and the distance covered is 6½ miles. The journey can be easily accomplished at the rate of 50 miles an hour.

A FLOURISHING electric club is in existence in Montreal, the members of which meet regularly at frequent intervals to discuss papers on electrical subjects and the technical phases of electrical work. The idea is one that should prove exceedingly helpful to workers in the electrical field, and promotive also of public interest in the science. We should be pleased to see clubs of similar character established in the larger cities throughout Canada. The members of the Canadian Electrical Association in the various cities might well take the initiative in this direction, as the benefits arising from the formation of such clubs would not be local only, but would extend to the national organization as well. Which city will be the first to follow the lead of Montreal in this matter.

THE thirteenth annual report of the Bell Telephone Co. shows that company to be in a flourishing condition. The gross revenue for the year was $875,526, and expenses amounted to $653,139 leaving a net revenue of $220,386. When it is borne in mind that the lines operated by this company now comprise 10,455 miles of wire on 4,836 miles of posts the large amount of expenses can easily be accounted for; in fact the company are to be congratulated upon being able to show so large a surplus. There is no doubt that during the coming year the subject of placing wires underground in all places where the trolley system is established, will have to be seriously considered, as the telephone service is greatly disturbed owing to induction. Already the company have placed 126¾ miles of wire underground.

FREQUENT complaints have been heard with regard to the hindrance to the work of the firemen in cities, caused by the numerous electric wires strung in front of buildings used for business purposes. In view of this, it is with pleasure that we report an instance in which the life of a fireman was saved during the recent fire in Boston, by means of an electric cable. One of the district chiefs of the fire brigade, who had gone inside the burning building became shut in by the flames, and could be seen at an eighth story window; from this dangerous position he made his escape by seizing one of the large insulated cables, and crossing hand over hand, to the opposite side of the street. A life saving net was stretched beneath him, as he slowly and with great difficulty made his way, and at last, utterly fatigued, was swung into the arms of his friends.

MR. E. O. Champagne, official boiler inspector in Montreal, has issued his report for 1892, which contains several interesting items. As the city now covers an area of 5,979 acres, and Mr. Champagne's work extends over this large territory, his office is a very important one, and it is gratifying to find the results so satisfactory. He made 1,397 visits of inspection during the year, and condemned 8 boilers and reported 46 as imperfect. There were 59 new and only seven second-hand boilers erected. The number of candidates examined to take charge of engines and boilers was 385, and of these 23 failed to pass the examination. In spite of all this work, Mr. Champagne rendered many services to the road, water, fire and health departments. He hopes during this year by the assistance of amendments to the by-laws governing his work to make his department one of the most perfect of its kind on this continent.

IN the controversy which took place in Toronto and Montreal, prior to the adoption of the trolley system, the advocates of the accumulator system stated that in Birmingham it had proved successful. A correspondent has sent us an article from the Birmingham *Post*, with regard to the substitution of the trolley electric system for steam traction on the Staffordshire Tramway Co's lines between Walsall, Bloxwich, Darlaston and Wednesbury. In this article the following sentence occurs:—"There is nothing new of course in electric traction, but the method adopted hitherto involves the use of accumulators in the cars themselves. The defects of this system, both from an engineering and commercial standpoint, have been sufficiently plain in the case of our own Bristol Tramway, that we are not surprised that Mr. Dickenson thought he could improve upon it." Thus it appears that in a much less rigorous climate than that of Canada, the storage battery system has proved a failure. In referring to this matter, we do so without any prejudice against the storage battery, which would certainly be the ideal system if the difficulties connected with its operation could be overcome.

THE annual convention of the National Electric Light Association of the United States was held on March 1st and 2nd in the city of St. Louis, and is described as having been very successful in point of attendance and interest. Papers were read as follows: "Long Distance Transmission of Power," by Chas. S. Bradley; "The Incandescent Lamp from a Commercial Standpoint," by Calvert Townley; "Power Transmission for Central Stations," by Dr. Louis Bell; "Remarks Concerning Power Transmission from an Economic Standpoint," by L. B. Stillwell; "Wrought versus Cast Iron for Filled Magnet Frames," by A.D. Adams; "Morals of Corporations," by E. A. Armstrong; "Relation of Insurance to Electric Lighting and Power," by Wm. Brophy; "The 'Vulcanizing' Process for Preserving and Strengthening Poles, Cross-arms, Ties, Etc.," by Harry C. Myers; "Underground Conduits and Conductors, and the Experiences of Electric Lighting Companies in New York City," by Wm. H. Browne; "Thermal Storage for Central Stations," by Geo. Forbes; "Some Experiences with the Alternating System," by R. H. Sterling. Dr. Bell's paper, which we regard as being of the greatest value to central station owners and superintendents, is printed in another place in this issue.

THE business community in the United States has been for some time past awaiting with pleasant anticipation the arrival of the 7th day of March, 1893, as the date on which the Bell Telephone Company's patents would expire. The hope was indulged that with the expiration of these patents, competition in the manufacture and sale of telephones would immediately set in, and telephone users would receive the benefit of reduction in rates. All these bright expectations, however, were disappointed when it became known that the Bell Telephone Company had recently been granted a new patent, known as the Berliner patent, under which the company might continue to enjoy a monoply of the business for a further period of years. The latest and most interesting piece of news on the subject is that on behalf of the United States Government, the Attorney General has entered an action to annul the Berliner patent, on the ground that it was procured by fraudulent means. It is alleged that the Bell Company were the means of delaying the issue of the patent from June, 1877, until November, 1891, greatly to their own advantage; and the demand is made for such a revision of the patent laws as would make it impossible for their objects to be defeated by individuals or corporations for their own benefit.

A BILL for regulating electric lighting throughout Canada was introduced in the Dominion Parliament shortly after the publication of our last issue. Information having been received by the President of the Canadian Electrical Association that many of the provisions of the bill would be likely to prove extremely burdensome to the electric lighting interests, a meeting of the Toronto members of the Executive Committee of the Association was hastily summoned, and it was decided that the President should go immediately to Ottawa, with the object of endeavoring to have the proposed measure amended in such a way as would remove its objectionable features. The President and some of the members of the Association resident in Ottawa, had an interview with the Comptroller of Inland Revenue regarding the matter, and pointed out to him that the lighting companies of Canada were not as a rule making even a fair profit on their investment, and therefore were not in a position to be saddled with the cost of the proposed inspection. It was also pointed out that it would not be possible for the Government to employ inspectors who would be competent to make an inspection of both electric light and gas plants, and therefore that two distinct staffs of inspectors would be required, which would necessarily involve a considerable expenditure. Since the interview referred to, the Government has seen fit to entirely withdraw the measure. Their reasons for so doing have not been made public, but we may fairly assume that the information furnished them has served to place the matter in a different light from that in which they had previously regarded it, owing to lack of information necessary to enable them to arrive at a proper conclusion.

THE officers of Montreal No. 1 C. A. S. E. met by invitation at the residence of Mr. Nuttall a few evenings ago, and considered means for raising the necessary funds to suitably entertain the delegates to the annual convention of the Association, to be held in Montreal next September. It was decided to recommend that the members resolve themselves into a committee of the whole to solicit subscriptions from friends and steam users.

IN December last the Toronto Incandescent Electric Light Co. reduced their price to customers from one cent per hour to eight-tenths of a cent per hour for 16 c. p. lamps. This step, the company state, resulted in almost doubling the volume of their business. Thus encouraged they have announced within the last few days their decision to further reduce the price to six-tenths of a cent per lamp per hour. At this price incandescent electric lighting should displace gas in business establishments at least. It is said to be the intention of the gas company to meet this cut in rates for electric lighting by a corresponding reduction in the price of gas.

IT may be of interest to some central station managers to know how an alternating current meter's record of light used or current consumed is measured and charged for, and to make it plain to those who may be groping in the dark, we will endeavour to point out the why and wherefore of it. To begin with, then, we have the ampere hour recording meter, whose dails are supposed to show the numbers that have passed through at a fixed voltage, prominent among which are the Schallenberger and Slattery, both being fairly accurate meters provided the voltage is maintained at 50, but with any greater or less amount of voltage, they vary in registering considerably more than the greater or less amount of current that may be forced through them from the increased or diminished voltage, the moving parts seeming to respond too freely to any increase or decrease of the pressure. They can be called accurate meters at 50 volts, but variable ones under other conditions. They measure the amount of current that passes through them by means of coils, between which is revolved, in one case a disc of metal, and in the other case a copper drum, the velocity depending on the amount of current traversing the coils. A small worm gear transmitting the motion to the clock work mechanism of the registering dials. These, as mentioned before, are made to read ampere hours at 50 volts, and as the general run of 16 candle power lamps consume about one ampere of current in one hour, it has been customary to tell the users that the price is so much per 16 candle power lamp hour, and in some cases the current is billed thus—that is, so many lamp hours at such a price. The best meter in use to-day is probably the Thomson Recording Wattmeter, and we are firmly of the opinion that the system of measuring the watts consumed and charging for them at so much per thousand watts is the right thing to do. In this case the central station is paid for all that is consumed and the watts are measured no matter what the voltage may be. Without wishing to discourage the use of other meters, we are fully satisfied that this system of selling current for incandescent lighting is the right one, and where a new plant is being installed should be the one selected. With plants that are already established and using other make of meters it would be quite a difficult matter to make use of this class of meter, simply because it would complicate matters considerably to have some meters registering amperes and others watts. Then again a customer with a watt meter might happen to have a next door neighbor who is using an ampere meter, in which case the wonder on the part of both of them would be why it was so, and each one would have his private opinion that his meter was put in different to his neighbor's to enable the company to try some scheme on him which would result in his paying more money for his lighting than his neighbor was doing.

THERE seems to be considerable agitation in different parts of the world as to the practicability of conveying power by means of the electric current over long distances. While we do not desire to enroll ourselves on the list of those who make the positive statement that power can in this manner be transmitted successfully from a commercial standpoint, yet we are decidedly of the opinion that the agitation is one in the right direction. True, high tension currents and dangerous to life would have to be employed; in most cases perhaps as high as 25,000 volts would be necessary; and it might require that the cross arms and poles have a death's head and cross bones painted on them to warn the unwary. Notwithstanding, these features of the proposal should not be sufficient to put a stop to experiments in the direction indicated. The same objections would apply to a steam road on which fast trains are being hourly operated, yet no one would think for a moment of resisting the building of such a road on account of any possible accidents that might happen on it, or on account of any deaths which might arise through such accidents. There is no doubt that a line can be built to carry such a high voltage as that mentioned; of course extra precautions would be required in its construction. The insulators would have to be of a special pattern, made to carry oil as an insulating medium. The wire would require to be well insulated with thick solid rubber core and ample covering to prevent abrasion. There would have to be some special method of fastening it to the insulators, and again the poles would require to be set not more than 75 ft. apart, so as to make the weight of wire between poles comparatively light, and thereby prevent any liability of the wires letting go between poles and falling to the ground. Guard wires both below and above would of course be an absolute necessity in districts where there would likely be any crossing of them by falling wires of other companies, as also to prevent their being brought in contact, should a new wire be strung under the high tension ones. We predict that it will not be many years before some such project will at least be attempted to be carried out.

ENGINES FOR ELECTRIC LIGHTING.

III.

THE frequent change of load and demand at certain hours, or rather at uncertain hours, for a much heavier load than the average are found in most power stations to be serious difficulties. A commonly adopted plan has been to have several steam engines, and to run one or more of these as required. At first sight this method seems very simple and effective; it is, however, attended with a very unsatisfactory result.

The engine is not the original source of the power, and when it is necessary to maintain steam pressure on a number of boilers in order to be able to meet sudden demands for power, there is considerable loss. The loss due to merely keeping fires banked with pressure on the boilers amounts to a considerable sum. The boilers and machinery are idle for a longer time each day than they are in use, and the expense of maintainance is about the same as if they were in steady or continuous use. These and other details, when carefully considered, show that what at first seemed such a simple solution of the problem, is at best but a make-shift.

Various schemes have been proposed and tried to overcome the loss. One plan recently proposed in England is to enable those having their plant arranged with a number of engines to save the loss caused by keeping steam up on the boilers. The author of the plan referred to is a well known professor of engineering. He suggests having a certain amount of power generated by the steam boilers in the usual way, and alongside of the steam boilers have a number of hot water reservoirs with furnaces under them. If 100 lbs. pressure be carried in the steam boilers, the hot water reservoirs would be loaded to a pressure of about 300 lbs. per sq. inch. Heat would thus be slowly accumulated in the water and stored there. When an extra demand came for more power another engine would be started, and to supply the steam hot water would be allowed to escape into the steam boilers from the hot water reservoirs. This water being at such high temperature would at once form steam, and so meet the supply for the extra demand. The proposal seems a good one, and one likely to meet the difficulty which has to be got over. It is a well known fact that water has a great capacity for receiving and retaining heat and under the plan suggested a great quantity of energy could be stored up in the hot water ready to be converted into steam for use in the engines.

Another plan which is in use is to have the engine considerably larger than required for the average load, and collect the surplus electricity in an accumulator, from which it could be drawn to meet the demands. This plan is in actual use in some places, but has a number of disadvantages arising from the first cost of accumulation and from losses in the storage and distribution of the electricity.

A modification which has been suggested is to have the engine larger than necessary for the average load, and to utilize its surplus power in pumping water into an elevated tank; when extra demands had to be met the water to be run back into a lower tank, and in doing so drive a water wheel. The same water would be pumped up again and used repeatedly. By this means an almost constant load could be maintained on the engine and boilers, which could thus be run in the most economical manner. In some places the power distribution is effected by means of water distributed in mains and delivered at a high pressure, in some cases as high as 700 lbs. per sq. inch.

A combination plant using electricity for lighting purposes, and to some extent for power, and water at high pressure for the main power supply, seems to be one which in some situations would be not only practicable but one which would prove convenient and economical.

The loss of efficiency in distribution of the water is due to friction in the pipes and to leakage at joints. These difficulties are now well understood, and the means required to keep them down to the lowest point are known. Water is not like unseen electricity or the subtle heat, both of which seem so difficult to manage in storing and transmitting.

In a power station combining these two systems the electric machinery would be driven by triple expansion vertical engines adapted to the average load, and a similar engine could be used to drive the water pumps by means of gearing. The water would be pumped into an accumulator loaded to maintain a uniform pressure in the mains. In ordinary cases the demands for light and for power would not be at the same hours. The main demand for light would be at night, and for power the demand would be during the day. The average of the two combined would be more constant and consequently the firing at the boilers would be more uniform and more economical.

The attention of engineers is at the present time much occupied with schemes for convenient and economical distribution of power. The electric system is not yet accepted as the best in all circumstances, and it is proposed in another article to give some information regarding some other methods.

Convenience, safety, economy and reliability or durability have all to be taken into account in considering the merits and demerits of any system. The steam engine and boiler are, however, at the foundation of nearly all the schemes and systems, and with all their faults they are as yet indispensable for civilized convenience and comfort.

PERSONAL.

Mr. G. Pink, M. E., has been appointed chief engineer at the main pumping station of the Toronto waterworks. His predecessor, Mr. Baxter, takes the post of assistant engineer.

There is said to be a likelihood that Mr. James Gunn will resign the position of superintendent of the Toronto Street Railway Co. and accept the management of a large financial institution.

Messrs, Wright & Garland have purchased Mr. Paul's interest in the electric lighting business at Carberry, Man.

Advices from St. John, N. B., state that the wires have been strung, the machinery put in the station, and it is announced that electricity will soon supersede horses on the street railway of that city.

TRADE NOTES.

The Reliance Electric Manufacturing Company, Waterford, Ont., have shipped to the Keegans-Milne Company, of Montreal, a 150 light incandescent plant.

Prof. Ellis, of the School of Practical Science, Toronto, after having made an analysis, certifies to the usefulness as a disinfectant and deodorizer of the compound "Phenyle," manufactured at Port Hope, Ont., by Mr. Alonzo W. Spooner.

The Eugene-Phillips Electrical Works, Montreal, have received an order from the Montreal Street Railway Company, for 90 tons of copper wire. This is believed to be the largest single order for wire ever given in Canada. The same Company have received from the Bell Telephone Co., orders to the amount of over 100,000 feet of aerial and underground cable.

The McGuire Manufacturing Company, of Chicago, has established a Canadian branch at St. Catharines, Ont., where it will manufacture all the specialties of the company, and particularly the well known McGuire trucks for electric railway service. By establishing this branch the McGuire company saves a duty of 35 per cent. imposed on American built trucks, and at the same time is in closer relation with the Canadian trade.

Mr. C. F. Medbury, the Montreal representative of the Canadian General Electric Co., has closed the following contracts for that company:—A 540 light plant for the Montreal Cotton Mills at Valleyfield; a 350 light plant for Knowlton, where the three wire system will be used with continuous current, as the station is located directly in the centre of the district to be supplied; and a 650 light plant for Waterloo. Here the station is located 3½ miles from the town, and alternating current at 2,000 volts pressure will be used with 10 volt transformers connected upon the three wire system.

On the 20th Feb. last, an extensive conflagration, which originated in some manner not yet elicited, upon the premises of the Keegans-Milne Co., Montreal, completely destroyed both building and stock, extending also to adjoining establishments. J. Ross, Son & Co's. Electrical Works suffered much damage to building, chiefly caused by the smoke-stack tumbling upon the roof and crushing in one half of it. The Messrs. Ross with business like promptitude immediately removed all their plant to other premises close at hand, and are now running as usual. Their loss, outside of removal, will be small.

The Reliance Electric Mfg. Co, of Waterford, Ont., report the following recent sales:—St. Thomas Gas Co., 100 H.P. 500 volt generator; The Brantford Electric Light and Power Co., 80 H.P. 500 volt generator; Lakefield Electric Light Co., 35 light arc dynamo; Wm. Cooke & Sons, St. Catharines, 40 H.P. motor; S. Taylor & Sons, St. Catharines, 5 H.P. motor; Walker & Co., Guelph, 10 H.P. motor; Lawson Bros., Toronto, 15 H.P. motor; H. R. Stewart, Toronto, 5 H.P. motor; Dominion Show Case Co., Montreal, 5 H.P. motor; John M. Poole & Co., Toronto, 7 H.P. motor; Wm. Gordon Osgoodby, Toronto, 10 H.P. and 2 H.P. motors; T. W. Ness, Montreal, 5 H.P., 7 H.P., 10 H.P. and 2 H.P. motors.

The Montreal Electric Co. is a new aspirant for public patronage in the electrical construction and supply line, being composed of Mr. John Shaw (late office manager for Messrs. J. & C. Hodgson) who assumes the general management, and who is perhaps one of the best known men in Montreal hardware circles. Mr. Wm. B. Shaw, whose name will be familiar to many of our readers, and who is deservedly popular with the electrical trade from his connection with T. W. Ness and the Royal Electric Co., is electrician for the firm, whilst Mr. Walter F. Taylor, the present able foreman for T. W. Ness, becomes mechanical superintendent for the new Company. With such a trio of hard and experienced workers there is no fear of the success which, with many friends, we heartily wish them, in their new undertaking.

For some time there has been considerable competition in Montreal among those wishing to handle the dynamos, generators, moters, &c., manufactured by the Reliance Electric Manufacturing Co., of Waterford, Ont. Mr. Slaght, the President of the Company, was in Montreal last week, and we understand decided to place the agency for the Province of Quebec, with the well-known electrical firm, T. W. Ness. We think this selection a wise one and a large business will no doubt be the result. A consignment of machines has already been received and may be seen at any time at the showrooms, which are centrally located, at 749 Craig St. The services of Mr. M. W. Corbitt, well-known in Montreal on account of having been for some years connected with the Edison General Electric Co. and latterly with the Royal Electric Co., have been secured by Mr. Ness for the purpose of looking after this branch, and the interests of the Reliance Co. will consequently be well looked after. Many firms are now putting in motors, thus avoiding the necessity of installing small engines and boilers, and we have only to look over the record of those installing private electric light plants to realize how rapidly this industry has developed.

The Toronto Incandescent Light Co., Ltd., have given notice of a further reduction in their prices of twenty per cent.

A charter of incorporation has been granted to the Hamilton, Waterdown & Guelph Electric Railway company, with a capital of $500,000. The incorporated members of the company are: Sir W. P. Howland, Toronto; W. Laking, lumber merchant, W. O. Sealey, accountant, Jacob Flatt and W. Deboss Flatt, timber merchants, all of Hamilton; Alex. Brown, shipper, John Ira Flatt, timber merchant, John Nicholson and Leopold Bauer, farmers, all of East Flamborough; John Owen McGregor, physician, and Chas Sealey, of Waterdown.

THE MOST ECONOMICAL BOILER AND ENGINE FOR CENTRAL STATIONS.*

By J. A. Farlinger.

Mr. President and Gentlemen: The subject we are about to discuss this evening is a rather difficult one to handle in the time at our disposal. When we consider the amount of knowledge which science, theoretical and practical, has put at our fingers' ends, it seems a gigantic subject for me to handle at all, so you will kindly overlook the brevity with which I shall deal with the subject. As this is my first effort at preparing a paper, I hope you will kindly bear with me during the reading of it, and not expect too much.

At the outset let me say it is not my intention to boom some particular make of boiler or engine; I think I shall have done my duty and served a purpose, if I define the necessary points that should be found in the boilers and engines of every central station. I have been somewhat puzzled, not as to what I should put in this paper, but as to what I should leave out.

I shall commence by stating that there is no such a thing as "horse power" to a steam boiler, it is a measure only applicable to dynamic effect, but as boilers are necessary to drive steam engines, the same measure applied to steam engines has come to be universally applied to boilers and cannot well be discarded. In consequence, however, of the different quantities of steam necessary to produce a horse power with different engines, there has been and is a need of an accepted standard by which the amount of water required to provide steam for a commercial horse power may be determined. This standard as fixed by Watt was one cubic foot of water evaporated per hour from 212° for each horse power. This was at that time the requirement of the best engine in use; at the present time Prof. Thurston estimates that the water required per hour per horse power, in good engines is equal to the constant 200 divided by the sq. root of the pressure, and that in the best engines this constant is as low as 150. This would give for good engines, working with 64 lbs. pressure, 25 lbs. water, and for the best working with 100 lbs., only 15 lbs. water per hourly horse power. The standard, as adopted by the Centennial Exhibition of '76, of 30 lbs. water per hour, evaporated from 212° for each horse power, is a fair one for both boilers and engines, but as the same boiler may do more or less work with less or greater economy, it should be required that the rating of a boiler be based on the amount of water it will evaporate at its highest economy. Parties have been known, and are known to-day, who claim an evaporation of from 19 to 20 lbs. water per pound of coal, when the highest that is practically possible, I believe, is only 13 lbs. of water per pound of coal. Such boilers are dear at any price.

I am informed that the results of 30 tests made of certain water tube boilers, gave an average evaporation of 11.4217 lbs. water per pound of combustible, which is a very high efficiency, being within 4% of Rankin's standard, and within 7½% of the highest theoretical efficiency. Prof. Thurston says, "The maximum conductivity or flow of heat is secured by so designing the boiler as to secure rapid, steady and complete circulation of the water within the boiler, and securing opposite directions of flow for the gases on one side and the water on the other."

The accumulation of scale inside and soot on the outside, will seriously affect the efficiency and economy of a boiler; only one-eighth of an inch deposit of soot renders the heating surface practically useless, only one-sixteenth of an inch of scale or sediment will cause a loss of 13% in fuel; a boiler must therefore be kept clean to secure the best results. The setting should be durable and kept in good order, as a loss of 21% has been known to be caused by poor setting. As an instance I might mention a case that came under my notice in a large town in Western Ontario where there was a saving of 25% effected in fuel, by a very simple thing, so simple indeed that the largest engine firm in the west made the error in installing the boiler, and I should not be surprised to learn they have made the same error in other places. Following are the requirements of a perfect steam boiler:

1. It should be simple in construction, and made of the best materials sanctioned by use.
2. It should have a constant and thorough circulation of water throughout the boiler, so as to maintain all parts at one temperature.
3. It should be provided with a combustion chamber, so arranged that the combustion of the gases commenced in the furnace may be completed before its escape to the chimney.
4. It should be provided with a mud drum to receive all impurities deposited from the water in a place removed from the action of the fire.
5. All parts should be readily accessible for cleaning and repairs; this is a point of the greatest importance as regards safety and economy, and has heretofore been possessed by plain cylinder and large flue boilers.
6. The heating surface should be arranged as nearly as possible at right angles to the currents of heated gases, and so break up the currents as to extract the entire available heat therefrom.
7. The boiler should have a large water surface for the disengagement of the steam from the water in order to prevent foaming.
8. It should have large and free passages between the different sections to equalize the water line and pressure in all.
9. It should have a steam and water capacity sufficient to prevent sudden fluctuation in pressure or water level.
10. It should have, if possible, no joints exposed to the direct action of the fire.
11. It should have a great excess of strength over any legitimate strain, and should be so constructed as not to be liable to require early repairs, or be strained by unequal expansion.
12. It should be durable in construction, perfect in workmanship and not liable to require early repairs.
13. The water space should be divided into sections, and so arranged that should any section give out, no general explosion can occur, and the destructive effects will be confined to the simple escape of the contents.
14. It should be proportioned for the work to be done, and be capable of working to its full rated capacity with the highest economy.
15. It should be provided with the very best guages, safety valves and other fixtures.

There are some six different classes or kinds of boilers in use to-day, which I have made a number of rough sketches of in order that you may better understand their different forms and constructions. The names of the different types are as follows: plain cylinder, flue, vertical tubular, tubular, locomotive and water tube boilers. Each type has its uses and likewise its abuses.

It is not my intention to go into the designing and proportioning of the different types of boilers, but rather to consider where the different types would be of efficient service, and in so doing we shall be able to pick out the type of boiler we require for any given power plant, whose surrounding conditions we are acquainted with.

Let us first consider the type of boiler known as the plain cylinder boiler, which is the simplest type of boiler in use, and is principally used in large iron rolling mills and coal mines—used in the first place because of the large amount of heat available from the heating furnaces, which would otherwise be wasted; again these boilers seem to meet the requirements in these places both as to cheapness of first cost, and being able to carry from 35 to 60 lbs. pressure to the sq. in., this pressure being sufficient to work the shear engines. In coal mines they serve the purpose because of the indifference as to the amount of fuel consumed.

The flue boilers, commonly known as the Cornish or Lancashire boilers, consist of a large cylinder with one or more flues passing through their whole length. Assuming many different arrangements as regards the flues, in this boiler there is considerably more heating surface than in the plain cylinder boiler, therefore from the form of its construction it is more economical in fuel; but it is hard to clean, and the design is poor, there being hardly two parts of the one temperature, therefore unequal expansion and contraction, and the fact that the greater the diameter of the flue the heavier metal and the more staying required, shows weakness; the circulation is poor because of the construction, which will cause wet steam and a tendency to foaming. This boiler would also be very serviceable where cheapness in first cost and a large supply of fuel to dispense with are necessary.

The vertical tubular type can best be defined by stating that it will serve the purpose in a way for a small steam plant of say 15 h. p. and under where economy in space is the only consideration. Apart from this, I would not use it or any other upright boiler, among which I include porcupine boilers, as the circulation is defective. They waste fuel in not being constructed to receive the full benefit of the flow of heat and are subject to foaming, to unequal contraction and expansion, are hard to clean, and have too many joints exposed to the direct action of the fire.

In the tubular we approach nearer the goal of perfection which it is ever our aim to attain. It has its defects though; the circulation is not as perfect as it might be; it requires careful attention, lots of cleaning, because of the position of its flues, is subject to a great variation in contraction and expansion of its different parts, is sometimes subject to severe foaming. On the other hand it has the advantages of a large heating surface, strong construction, fairly economical and steams well.

The locomotive boiler I shall not touch upon, as it is not used to my knowledgo for electrical purposes.

We now come to the most efficient type of boiler now in use—it is the water tube type. Its advantages are many, its efficiency is very high, reaching nearly the highest practical point of evaporation. Its circulation is perfect; it has few or no joints exposed to the direct action of the fire; is so constructed as to even the action of contraction and expansion in all its parts; is easy of access, easy to clean; no general eruption or explosion can occur; it utilizes the greatest amount of available heat, which flows at or nearly at right angles to the circulation of the water; is so constructed as to give as dry a steam as possible; is very durable, and will stand almost any amount of abuse.

What I have said of the sketches of boilers before you this evening will apply generally to the different makes of each type of boiler, with few exceptions.

Having considered some of the points in favor and against the use of the different types of boilers, let us turn our attention to some of the necessary fittings. We shall first deal with the steam guage. About the year 1849 Eugene Bourdon, a Frenchman, discovered that the free end or ends of a flattened tube, with enough elasticity for use as a spring, would move when pressure was applied through the medium of a fluid, externally or internally; that the motion was in direct proportion to the pressure applied; and when the pressure was removed, it would assume its former position. He at once conceived the idea of a new pressure gauge, in which this should be the main spring or means of motion, and which, as originally designed, far excels any other instrument for sensitiveness and accuracy; but is best adapted for measuring low steam pressure and vacuums, or wherever a very delicate instrument is required. As it is more efficient to carry high steam pressures, so do we want a gauge to meet the demands for registering higher pressures; another point against it being the position of the tube; if we are not using it continually in winter the steam condensing in the lower end of the tube is either likely to severely strain or burst it.

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* Paper read before the Montreal Electric Club.

There have been several improvements on this gauge by Crosby and others. It originated from observations made of the motions of the free ends of the springs or tubes already in use while under variable pressures. It was found that not only the horizontal motion of the springs could be utilized, but also that of the perpendicular or upward action of the same spring, if a given length, and that by uniting these motions by proper mechanism it could be transmitted to the pointer. This permitted and required stiffer springs for measuring like quantities of steam than any before used. Experience has shown that under no circumstances of pressure employed, within the amount indicated on the dial, can they be straightened or their original elasticity affected. This device also avoids and prevents any vibration of the pointer under action. Being held at their lowest points and having no dip, the water is allowed to return to the siphon, thus preventing and removing the danger of freezing by extreme cold. While these gauges partake of all the good qualities of the original Bourdon, the defects are carefully eliminated, and the use of springs 100% stronger than in other style gauges is permitted, so preventing its setting under any pressure that may be indicated on its dial. There are other style gauges which I shall not take up your time with describing, some of which have long since gone out of use, among them being Smith's gauge, the mercurial, the long barometer and the short barometer gauges.

We now come to one of the most necessary adjuncts of a boiler—the safety valve. The first one we shall deal with is Salter's spring balance. My reason for dealing with this one first is that where it has been used it has served the purpose of a safety valve and steam gauge combined. The principle is exceedingly simple; it is the ordinary safety valve and lever, and instead of a weight at the end of the lever, there is a threaded spindle brought up through the end of the lever with a nut on the upper side. On the lower end of this spindle is a spring, the bottom of which is anchored to a brace in some convenient place on the boiler front about 4 feet from the ground, and is incased in a brass tube on which there is a stationary scale, and on the outside of this is another casing fastened to the spindle just above the top of the spring.

The next is the ordinary safety valve with which you are all more or less acquainted. This valve has much to answer for, owing to the friction of its parts. It will not open until the pressure is above what it is set at; it will continue to blow off after the pressure of the steam has fallen far below the point of opening; it wastes large quantities of steam, which is enough in itself to condemn it.

We now come to a valve which is in common use to-day and seems to meet with a great deal of favor, belonging to a class of valves known as pop safety valves. The one before us this evening is Mr. G. H. Crosby's patent. The design is unique and the mechanism perfect. It is positive and direct in its action, and when properly adjusted and taken care of, is sensitive to act. Another valve of the same type, not so common, but which is probably just as efficient, is the Scovell safety valve. It is claimed for this valve that its relieving capacity is not restricted, and that it lifts to its full height with all pressures, presenting an opening equal to the area of its discharge pipe. Its seats are of the simplest form, and its precision of action is not subject to derangement by the wearing of its valves or their seats. No special adjustment is necessary. The seats can be reground or renewed without special skill. The friction surfaces are reduced to a minimum; the springs not subjected to violent and sudden compression. It is thoroughly self contained; exempt from the dangers of being tampered with; opens with promptness and closes with a slight loss of pressure. Of course these are only two of the several valves of this type, all of them more or less efficient.

There is another safety valve which I might call your attention to this evening, more because it is very little used to-day. The valve is known as the reverse valve, vacuum valve, internal safety valve or atmospheric valve. The purpose it was intended to serve was to prevent the boiler from collapsing from external pressure of air, because of the vacuum caused by the condensation of the steam. The idea is good, but it is doubtful if the boilers of to-day require such a protection, they being much more strongly constructed and of a different type from the boilers of a very few years ago.

In conclusion I might say of the boiler plant: on it depends two-thirds of the efficiency of our power plant; in it lies the power to destroy our dividends, our property and our lives. Can we therefore be too particular in our choice of a boiler and its construction, from the raw material to its setting, and the other fixtures necessary for its operation?

You will perceive I have not spoken of the furnace and chimney; these are worthy of a separate paper. With regard to injectors, there are a number in the market, most of them giving satisfaction if properly handled. I might say that some inventors claim that with the use of their injectors feed pumps and heaters are a useless expense, and in a majority of cases they are right. Concerning fuel economizers, heaters, and feed pumps, it would take up too much time to discuss their merits, which in many cases are very doubtful.

Let us now turn our attention to the second great factor in the utilization of steam power, namely, the engine; the economy of which is expressed in terms of the number of lbs. of water consumed per H. P. per hour. The rate of water consumption is the only expression which should be used, as applicable to the efficiency of an engine, as the amount of fuel used must depend largely upon the kind of boiler used, its condition, the manner in which it is set and fired, the quality of fuel, the draft, and numerous other conditions for which the engine is in no way responsible. This rate may be found by the following rule: Divide the constant number 859,375 by the volume of steam at the terminal pressure, and by the mean effective pressure—the quotient will be the desired rate. With non-condensing engines, the best possible economy, with a given boiler pressure, is theoretically obtained when the full pressure is admitted to the cylinder up to the point of cut-off, and the degree of resulting expansion is such that the terminal pressure is lowered to, or nearly to that of the atmosphere, provided that the construction of the engine is such as to combine with a free exhaust and induction the least possible loss from clearance, friction, leakage and condensation. Under such conditions the steam may expand until there is no more work in it, and no higher economy is possible with a given boiler pressure without a condenser. The best theoretical economy with a given load and boiler pressure is obtained when the cut-off takes place as early as possible in the stroke, consistent with obtaining the average pressure necessary to do the work and maintain the proper speed. A first-class boiler will deliver to the engine 75% of all the energy in the combustible, or say 10,875 out of a total of 14,500 heat units, or allowing 8% for ashes, 10,000 heat units for each pound of coal burned. This represents 7,720,000 foot pounds of energy, which, if all utilized by the engine, would give 3.9 H.P. for one hour, at the rate of .26 lbs. coal per H.P. per hour. But the most efficient engines yet built have only attained 1½ lbs. coal per hour, or the small amount of 17% of the energy delivered by the boiler, while the averge engine uses 3½ lbs. coal per hourly H.P., and discharges unused 93% of the energy delivered to it. Of course the greater part of this loss is in the latent heat of the steam which is exhausted into the atmosphere or condenser, as the case may be, and is unavoidable so far as now known.

Compound engines with high pressure boilers have an advantage over single cylinders, and under some conditions where a large amount of power is needed steadily, triple and quadruple expansion engines work with a saving, but I think it is safe to venture the statement that triple expansion or quadruple expansion engines are yet impracticable for central station work in Canada.

Let us turn our attention to engines that are suitable for our central station work. We shall first speak of the high speed engine, the theory of which is, the longer steam remains in contact with a cooler surface the more it will be condensed, therefore we require a short cylinder to use a little steam at a time, use it very quickly, and keep the temperature of cylinder and steam chest up as high as possible, the result being a high speed. Suppose we carry this theory a little further and compound one high speed engine; it would result in a saving of about 16% of coal and 14% of water; and if we go still further and add a condenser, we shall effect a still greater saving. Another thing in the favor of high-speed engine is that it dispenses with the necessity of a counter shaft, pulleys, bearings and extra belts, the cost of maintaining which is no small item in itself.

In a slow speed engine the cooling effect of the expansion penetrates further into the metal of the cylinder, requiring more condensation at each admission to reheat it, therefore is more wasteful of steam. If we compound it and then make it condensing, we add to its efficiency as in the case of our high speed engine, but the saving (though I could find no results of actual tests) I believe is less than in the case of our high speed engine. With a slow speed engine it is necessary to have a counter shaft, etc., together with the extra cost of maintaining it. In high speed engines the valve gear is positive and direct in its action, has a wider range of cut-off, is more sensitive to variation in load, governs quicker and better, therefore is more reliable under all circumstances.

In the best styles of slow speed engines, such as the Corliss, Wheelock and Brown engines, there is too much intermediate gearing upon which to depend for a positive action of the valves. I have personally noticed both on a Corliss and Wheelock engines, the valves miss action time after time.

I am not prepared to go into the principles and construction valves and valve gears this evening. The governors on these engines are very sluggish in their action and not to be depended on, under any circumstances. This is a broad statement, but a true one.

The repairs on a high speed engine, if thoroughly constructed, are decidedly less than on a slow speed engine of equal construction. I state the following as a fact, given me by the manager of a very large concern, having a number of engines in use, both high and slow speed, of different capacities; that his slow speed engines, though running only 10 hours per day on a steady load, required more attention, and the repair bills of slow speed engines were as 100 to 1 to the high speed engines. He also stated that two Westinghouse high speed engines had yet to cost him five cents for repairs after five years' run, averaging 14 hours run per day. Of course there are exceptions to this, as I know a case in this city where there is a Corliss and an Armington & Sims engine, in which the results I have just recited are reversed, but there was a reason for it.

It is my belief that within a very few years we shall see high speed engines of upright construction used entirely. The wear is less, and strains are taken more easily and less room occupied.

It might be well to put a limit to the foregoing statements by saying that I would advise the use of high speed engines up to 200 H.P., and a slow speed engine for any larger power plant, to be compound and condensing, except in the case of the high speed engine where you only require up to say 35 or 40 H.P.

Concerning condensers, I should very much like to read you Mr. J. H. Vail's letter on condensers in his article on "Increased Commercial Efficiency and Higher Economy in Central Stations," but I have already taken up too much of your time. In conclusion I might say it is impossible to lay down a fixed rule for making a choice of engine for a central station, as the requirements and demands are different in nearly every case—you should be governed by the work to be done, the cost and supply of fuel and water. First ascertain these facts, then make out your specifications accordingly.

Gentlemen, I thank you for your kind attention this evening and I am only sorry I could not make my paper more interesting. I might also state that to Mr. Pinolet and Mr. H. R. Lockard are due the thanks of the club for the sketches before you this evening.

SPARKS.

Cairo in ancient Egypt is to be illuminated by electric light.

Mr. H. W. Petrie, Toronto is replacing his engines with an electric motor for running his machine shop.

Representatives of American oil firms are in Toronto seeking to establish petroleum as fuel for engines.

An electric light plant is being installed in Messrs. A. G. Van Egmund & Son's woolen mills at Seaforth.

A railway car-brake has been invented operated by electricity and is said to be as serviceable as an air brake.

A company has been formed in New Denver, B. C., to build a tramway, electric light plant and waterworks.

Letters-patent incorporating the St. Jean Baptiste Electric Company have been issued. The capital stock is $100,000.

The Royal Electric Co. is providing the whole of the plant for the new electric light company of Smith's Falls.

The council of Victoria, B. C. are going to take over the street railway of that place as well as the electric light service.

A complete set of electrical cooking appliances is to be placed on the new steamer Columbus. This will be the first vessel thus equipped.

Mr. Joseph Hancock, of St. Catharines, is said to be the first man to grind a saw by electricity. The event took place on February 28th last.

The Windsor and Amherstburg Electric Railway has been purchased by the Citizens Electric Light Company and others of Windsor for $156,000.

Great improvements are being made to the electric light works at Nanaimo, B. C. Many miles of new wire for the incandescent and arc light system are being fixed.

Messrs. F. Nicholls and J. H. Quinlan, of Toronto, and A. J. Corriveau, of Montreal, attended the National Electric Light Association Convention at St. Louis last month.

Messrs. Leitch & Turnbull, of Hamilton, have built an electric elevator for the Winnipeg warehouse of Messrs. James Robertson & Co. The power is supplied by a Kay motor.

A delicate and quick reading electrical thermometer has been introduced by a Frenchman. It is capable of showing a change in temperature of one-twentieth of a degree centigrade.

The Royal Electric Light Co. have provided the Pembroke Electric Light & Power Co. with an 800 light alternating dynamo. This addition to their plant is for providing light to outlying districts of Pembroke.

Belleville is likely to have an electric street railway system covering a distance of eight miles. Messrs. A. J. Close and R. H. Fraser, of Toronto, are to report as to the feasability of the scheme and the probable cost.

The Northey Manufacturing Co. have fixed one of their plunging pumps upon the premises of the Allen Manufacturing Company. They also have sent two artesian well pumps to Montreal to pump from wells 140 feet deep.

A. E. Thompson pleaded guilty in Toronto police court to a charge of embezzlement from the Bell Telephone Co. He was committed to gaol for 60 days.

At a meeting of the Portsmouth, Ont., council a motion was passed for presentation to the Ontario Legislature asking that body to grant the street railway company power to substitute electricity for horses as a motive power.

The Dodge Wood Split Pulley Co. have provided the Ottawa Electric Light Co. with 300 h. p. rope drives. This latter company is said to be the first to transmit the whole of their power with rope drives instead of leather belting.

Electricity is to be used in the manufacture of bleaching powders, the amperage to be equal to affording sufficient heat to decompose common salt from which chlorine is obtained. Starch of the lower qualities can be bleached by electricity.

The following officers have been appointed by the directors of the National Electric Tramway and Lighting Co., of Victoria, B. C., for the following year: Hon. D. W. Higgins, president; T. J. Jones, vice-president; Major C. T. Dupont, secretary-treasurer.

Messrs. Cook & Son, of St. Catharines, Ont., have just completed, for supplying power to factories in that city, an electric power station having a 100 horse power generator 500 volt machine. The generator is loaded with Reliance motors and all the available power is being used.

An Ottawa electrician claims to have discovered a process for utilizing electricity to abstract the heat from cast iron blocks until they are reduced to the temperature of ice, and then using them as a substitute for natural ice. He claims that this can be done at a price to compare favorably with the latter.

An invention is being patented in the States and England of a new trolley pole. It is made to work from a point two feet above the car, and is so arranged that in case of accident and the connecting wheel missing the circuit wire it brings itself into a horizontal position by means of balance weights.

The Canadian Whitney-Hoyt Electric Co., are about to open up the old Edison Factory at Sherbrooke, P. Q., for the manufacture of electrical instruments, especially ammeters and volt meters, for the Canadian market. Mr. F. T. Dunlap is president of the company, and Mr. Adam H. Hoyt, M. D., electrician.

An electric bit for vicious horses has been invented by a citizen of Hamilton, Ont. A small battery is carried in the vehicle and wires are connected from it through the head gear to the bit. When the animal begins to kick, a button is pressed to bring into operation the electricity, which, it is said, will speedily stop such dangerous business.

An interesting paper was read by T. R. Roseburgh, B. A., lecturer in electrical engineering at a recent meeting of the Toronto School of Science Engineering Society on "Compensation as an Aid to Invention." Explanations of methods for solving telegraphic and telephone problems and other matters on these lines were dwelt upon. A discussion on the paper followed.

Excitement prevails in Cote St. Louis, near Montreal, over the claims of the two rival companies for the electric railway franchise. A council meeting was called recently for the purpose of signing a contract with the Montreal Street Railway Co., and Mr. A. J. Corriveau, the other claimant, has sued the municipality for $50,000 for alleged breach of contract. The meeting referred to broke up amid great confusion. Neither the Street Railway nor the Corriveau Co. have yet the contract, and the matter is at a deadlock.

In spite of the vigorous opposition against the Toronto & Richmond Hill Street Railway, the York township council has passed a by-law authorizing the construction of the proposed road. The Township Council have no doubt done what they deem to be right in the matter, and their decision will be welcomed by the people most concerned, who showed their approval of the new railway by granting to it a bonus of $60,000. The work is now to be pushed on, and in our next issue we hope to give some details concerning the railway itself.

TELEGRAPHING MR. GLADSTONE'S SPEECH.—In view of the telegraphic despatch of reports of Mr. Gladstone's speech on Monday evening last, great preparations were made by the postal telegraph officials. Extra Wheatstones and "punchers" were fitted up at the central telegraph office, wires were added to all the principal circuits of the kingdom, and several towns not normally in direct connection with London were put through. The main East Coast line of the Postal Telegraph Department carrying twenty important wires, was subjected to considerable damage near Hatfield on Monday morning. Some workmen engaged in cutting trees allowed a heavy branch to fall right across the wires, smashing all of them at that point, and breaking six wires and four wires in the two adjacent spans. The accident occurred between twelve and one o'clock. The sectional engineer, Mr. Parkinson, was at Welwyn at the time, and received intimation of the disaster at 1 p.m. He drove at once to Hatfield, a distance of 10 miles, taking with him a line man and some necessary stores. They arrived on the scene of the breakdown at 1:50, got three of the wires through by 3:15, and the whole 20 were again working by 4:10. This was sharp work, and enabled the line to carry its share of the very heavy traffic caused that evening by the introduction of the Home Rule Bill. Three-quarters of a million words were sent out on Monday evening from the Central Telegraph Office; this is a very high figure, but it has been exceeded on two or three occasions.—*The Electrician.*

SCALE FORMERS.

The following is a list of substances most commonly found in natural waters: Carbonate of lime, carbonate of magnesia, sulphate of lime, silica.

The above substances, when present in quantity, readily form scale, though it will be noted that some of them by decomposition very often aid in incrustation: Chlorides of sodium, potassium, calcium, magnesium, potassium; nitrates of sodium, calcium, and magnesium.

Carbonate of lime is most abundant in nature, and is found in nearly all natural waters, either in traces or in quantity. Carbonate of lime itself is soluble in water only to the extent of two or three grains per gallon, and this solubility rapidly decreases as the temperature rises; but when the water also contains carbonic acid in solution, the solubility of the lime salt is enormously increased, and as much as 85 grains per gallon may be dissolved. The bicarbonate of lime thus produced constitutes the contemporary hardness of water, so called, because on boiling, the carbonic acid is expelled and the carbonate of lime is deposited. Hence a water of this class can be partially softened by boiling. The precipitation of the carbonate of lime commences at a temperature of 150° Fahr.; and is complete according to M. Couste, at a temperature of 290° Fahr.—that is, at a working pressure of about 60 lbs. where there is little sulphate of lime; the incrustation resulting from the latter salt may be reduced to a minimum by the judicious use of the blow off cocks, as the carbonate of lime falls as a soft sludge, which remains soft for a considerable period, and may, therefore, be blown out. Many of the carbonate of lime scales are produced by emptying the boiler whilst the plates and brick-work are hot, and the soft sludge is thus backed on the plates.—*Industries.*

SPARKS.

Steps are being taken to provide Kingston with an electric railway.

A charter has been granted to the O'Kanagan, B. C., Telephone Co.

A new electric lamp has been invented by Mr. W. Grant, Embro, Ont.

Capt. T. G. Craig has asked for a franchise of the Kingston streets for an electric railway.

Messrs. S. Taylor & Sons, Merritton, Ont., have installed a lighting plant in their woolen mill.

The General Electric Co. has been granted a franchise for an electric street railway in Peterboro.

The business of making arc lamps for incandescent circuits is getting to be a big one in the United States.

The Davenport Street Railway Co. are asking for a franchise to extend their tracks from West Toronto Junction to Swansea.

The capital stock of the Chaudiere Electric Light and Power Company (limited) has been increased from $500,000 to $1,000,000.

Mrs. Collins has been granted $6,000 damages against the Hamilton Street Railway Co. for the killing of her husband by a trolley car.

The new Electric Street Railway Co. at Brantford will give eight tickets for 25 cents, from 6.30 to 8.30 a. m., 12 noon to 1 p. m. and 5.30 to 7 p. m.

An electric railway is to run between Hamilton, Grimsby and Beamsville. A company has been formed and arrangements made for commencing operations.

Mr. Charles Mosely is the new water and electric light engineer to the North Toronto Council. The late engineer, Mr. Wilford Phillips, has gone to Niagara.

The electrical exhibition at the Crystal Palace, England, was not a financial success, the total income being $45,000 less than from the exhibition the previous year.

The Bell Telephone Co. has been granted an exclusive franchise at Chatham for five years in consideration of a grant of $705 a year to that town, to be "taken out in trade."

A Frenchman has succeeded, it is said, in producing an excellent driving belt by parchmenting the leather instead of tanning it. The belts have greater durability and do not stretch.

A lively controversy has been going on between the Halifax council and its street railway over the removal of the snow. The company shovelled it off the tracks and the city shovelled it on again.

The Berlin & Waterloo Street Railway have obtained permission to change their present system of running their cars to that of the trolley, and the plant will be shortly in course of erection.

Mr. H. A. Everett, vice-president of the Montreal Street Railway Co., will probably take the presidency of a consolidated railway company in Cleveland, Ohio, with a capital stock of $8,000,000.

A large number of Hamiltonians are protesting against the speed the trolleys run on James St. North. It is said the vibration was so great that the plaster fell off the ceilings in houses along the street.

It may sound like American humor, but still it is a fact that there is a pensioner of the United States Government who has been receiving nineteen dollars a month for deafness, and at the same time drew a salary of $1,800 a year for attending a telephone.

It is proposed to build an electric railway from Galt through Preston, Freeport and Berlin to Waterloo. The Waterloo County Electric Railway Co. has been formed to carry out the work, with a capital of $450,000, divided into 4,500 shares of $100.

The Montreal Street Railway Company have ordered 25 new cars from Belleville, Ont., to be delivered on May 24. The company have 115 new electric cars now running, and they expect to have 400 electric cars running in the streets of Montreal within two years.

Hon. G. W. Ross, Minister of Education, has asked the North Toronto Council to supply Upper Canada college with electric light from their works. The council decided at a recent meeting to ascertain how much light is required and the probable cost of changing the engine and boiler.

James P. Dawes and John Torrance, of Montreal, and others ask for incorporation as the Automatic Telephone and Electric company of Canada, with head office at Montreal, and power to manufacture, operate and deal in telephone instruments and electrical appliances throughout Canada.

Long distance telephoning has called into existence a class of operators who are valuable by reason of the clearness and sharpness with which they can pronounce words while speaking rapidly. It has also developed the fact that the French language is better adapted to the purposes of the telephone than the English.

Mr. McBride, of North Toronto, has served notice of action upon the county solicitor to restrain the Metropolitan Railway from running on Yonge street, and all other railways running elsewhere empowered by a York county franchise. The point raised is that only local municipalities have the right to grant such franchise.

An interim injunction, until the trial of action, has been granted against the Town of Port Arthur on motion of the Town of Fort William, preventing them from proceeding to construct a street railway upon any of the streets in the latter town, unless the same be done to the satisfaction of William Murdock, the town engineer.

PERFORATED BELTS.—An engineer has been inquiring of us as to the value of belts perforated with holes. The argument of the dealer is, that the air is let out through these holes from under the belts, and being thus excluded, atmospheric pressure must be excluded and the pressure of the atmosphere upon the pulley will help to secure a firmer grip without further tightening. This is on the supposition that air is carried under the belt in the rush of the belt on the pulley. This engineer does not want to pay for perforated belts if they do not do what is claimed for them, and yet he wants all the adhesion he can get with the least tightening. We do not believe that atmospheric pressure has anything to do with the driving of belts, and has no part in causing them to adhere to a pulley, whether perforated or not. It has been found that at high speed belts do not adhere so well to pulleys as at a slower speed, and this has been claimed to be due to the air getting between the belt and the pulley at the high speed and preventing less adhesion from atmospheric pressure. It can be quite clearly demonstrated that the centrifugal force of the more rapidly moving belt counteracts to some degree the adhesion of the belt and causes it not to adhere so firmly. This is the cause of this peculiarity, not the taking of air under the belt.—*Boston Journal of Commerce.*

Mr. A. T. Smith, manager of the Bell Telephone Company's Exchange, at Kingston, recently read a paper on "Lightning Rods, their Usefulness and How to Construct Them." In answer to the question, what is a good lightning rod? Mr. Smith said: Copper being the best conductor of electricity it follows that a protector constructed of that metal is superior to any known device. The ideal lightning rod is composed of stranded copper wire, making a cable of about ⅝ to ¾ inches in diameter. This cable is fastened securely to the ridge and side walls of the building by staples driven through the wood work. It is a mistake to insulate a lightning rod from the building; on the contrary, all masses of metal, such as valleys, eave troughs, metallic cornices, &c., should be connected with it. The rod should project above the roof or highest part of the building, or in other words the height of the rod should bear a certain proportion to the size of the building. The lower end of the rod should be carried down into the earth until it meets permanently damp or wet ground, where it should be attached to a fairly large metal plate, or if gas or water pipes are available the rod should be connected with them and firmly soldered. With such a rod little fear may be had of lightning destroying your property, but copper is expensive and a very good substitute may be found in iron, especially if galvanized.

Four-fifths of the engines now being used in the world have been constructed during the last 25 years.

If ever a shop hand is called upon to splice a woven belt, he must be prepared to do a pretty good job with the needle and thread, says the *Journal of Commerce,* and have all the time he may ask for at his disposal, as each separate warp thread must be bound together, rope-spliced fashion, and no two thread ends must come side by side, as it would destroy the even thickness of the splice; and where two or more ply belts are to be united, each ply can be handled in single-ply style, breaking joints as in splicing ropes with the same number of strands, then work in a flexible cement of some kind to bind the fibers and keep them from working upon each other.

OIL VERSUS AIR AS AN INSULATING MEDIUM.

As the result of a series of experiments, Mr. J. B. Williams, in a communication to the American Institute of Electrical Engineers finds:—1. That air, even when it has a humidity of 80 per cent., is infinitely superior to oil for insulating conductors carrying high tension currents. 2. That pure paraffin is far superior to oil, both for insulating conductors and preventing the escape of the current across the surface of glass. 3. That air having a humidity of 80 per cent., is superior to paraffin as an insulating medium. 4. That oil will not prevent leakage of the current across the surface of glass. 5. That whenever oil covers the surface of hard rubber, even when the latter is paraffined, it destroys the high surface insulation of the paraffined hard rubber; that is, the low surface insulation of the oil has been substituted for the higher surface insulation of the hard rubber, when used bare and clean, or when covered with paraffin. The writer also shows that there is but little difference in the specific resistence of different kinds of vegetable fibre when the fibre is clean and absolutely dry. The resistance of such fibre is high as long as it remains in this condition. But it is almost impossible to keep it so. It may be a matter of surprise to many to learn that cotton which has been dried, and which, therefore, possesses good insulating properties, loses these properties in less that 10 minutes if exposed to a damp atmosphere. Paraffined wood is very apt to be of little use in a short time, for no matter what kind of soft porous material is paraffined by allowing it to absorb the melted wax, the wax rarely hardens in a solid form, but usually contains numerous small spaces, and these spaces absorb moisture by capillary attraction. It is for this very reason that a dielectric which is formed of fibre saturated with paraffin soon loses its high insulation when exposed to the air. The microscope will demonstrate the presence of these minute air spaces.

RAILWAY TELEPHONY.

Mr. C. A. Hammond, superintendent of the Boston, Revere Beach & Lynn Railroad, in a recent paper published in the *Railroad Gazette*, calls attention to the growing tendency among railways to the use of the telephone in place of the telegraph in the transmission of train orders; and he urges its wider adop-for the purpose. Within the past year or two, the entire telephone service of his road has been changed to copper metallic circuit, using long distance transmitters with sufficient battery power to allow a dozen or more instruments to be placed on a single circuit: individual calls being distinguished by long and short rings as in Morse code. Care has been taken to neutralize induction, and the line is found to be perfectly quiet day and night. The writer is of the opinion that there is no reason why the telephone, if proper precautions are taken, is not preferable to the telegraph for this class of work. The rule has been for the sender of a message to write it down as he talks and have the receiver write down what he hears, repeating the message as a check. As an instance of working of the system, Mr. Hammond states that he has on file 2,500 train orders in which there is not a single error.

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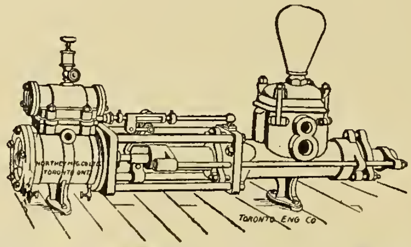

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SPARKS.

The Bellechasse Telephone Co. has been incorporated.

Tenders are being asked for lighting Leamington, Ont., by electricity.

An incandescent electric light plant is being installed at Mitchell, Ont.

The ratepayers of the township of Etobicoke have granted the Toronto and Mimico electric railway a bonus of $10,000.

A deputation from Orillia visited Toronto Junction recently for the purpose of inspecting the electric light plant, having in view the purchase of plant.

The High Level Bridge Co., have been given the privilege of supplying electric power throughout Grantham township, and also the right to build an electric railway.

Mr. G. Forbes, of England, consulting engineer for the Cataract Construction Co., has stated that wires conveying power should be placed underground if possible.

The Toronto Incandescent Light Co., will apply for a special Act from the Ontario Legislature empowering them to construct and operate a street railway in Toronto and other municipalities in the County of York.

It is proposed to join Arkona, Forest, Strathroy and adjoining places by means of an electric railway. The line will cover a distance of 32½ miles, with stations at convenient intervals. Telegraph and telephone lines will be constructed along the route. If the places interested will grant the required bonus of $75,000, it is said the line will be put into operation inside of four months, although no actual company yet exists.

The Canadian General Electric Co. is making preparations for starting business in London. Plans have been prepared for a power house to be erected on Thames and Bathurst streets. The power house will be 85 × 130, and will have from 1,000 to 1,200 horse power boilers and engines. The total cost of establishing the plant will be about $100,000, and the area over which it is intended at first to extend the wires will be within a radius of half a mile from the power house.

Electric light at Smith's Falls is very cheap to the consumer. He can burn nine 16-candle power lights all night for $12 per year. This is on account of there being two rival electric light companies in the town.

The Bell Telephone Co. has been given an exclusive right, on paying $1,000 a year, to supply London, Ont., with a telephone service, and the Canadian General Electric Co. has been given a franchise at the same place for incandescent lighting.

While engaged at their avocation at the corner of Yonge and Richmond streets, Toronto, two surveyors were thrown violently to the ground by coming in contact with a gas pipe which had become charged with current from the street railway company's wires.

Mr. Dingman, general manager of the Toronto and Scarboro' Electric Railway, has asked the East Toronto council for a right of way to be granted to his company on the main streets for the electric car service. If this is arranged the line would be in active operation by July 1st next.

The Montreal Street Railway Co. are about to build their new power house, which will be completed, it is expected, by next fall. A large number of new cars have been ordered from Belleville, and it is stated that within two years the company will have four hundred cars running in Montreal.

The Toronto and Richmond Hill Electric Railway Co. have been informed, through Mr. T. Caswell of the city solicitor's office, Toronto, that they cannot run their cars within that city. He has also written, asking the Toronto and Scarboro Electric Railway Company for plans and details of their proposed routes affecting Toronto.

At a recent meeting of the shareholders of the Kingston Light, Heat and Power Co. the following officers and directors were appointed: Mr. R. T. Walkem, president; Mr. R. Kent, vice-president; Mr. B. W. Folger, manager; Messrs. T. A. Breck, J. S. Muckleston, W. Nickle, W. McRossle and F. A. Folger, jr., directors. A dividend of 5 per cent. was declared on the company's capital stock.

An English syndicate with headquarters at Montreal has a bill before Parliament to secure power to buy up and amalgamate all the electric light, as well as gas companies in Canada. The transfer of the controlling interests in the Ottawa Gas Company and the Ottawa Electric (arc) Light Company to the syndicate has already taken place, the transaction involving the exchange of $500,000 in money. The capital stock of the two companies together amounts to about $650,000, and the newcomers have purchased from the holders about $500,000 of stock in order to have a controlling interest. The Ottawa Electric Light Company are possessed of valuable privileges, and own their own water power, besides a magnificent plant, at the Chaudiere. Among those who have figured prominently in this deal we find Senator Clemow, Col. Allan Gilmour, Mr. R. Blackburn and Mr. S. Howell. The Ottawa Gas Co. are to hold their annual meeting this month when probably some further details will come to light.

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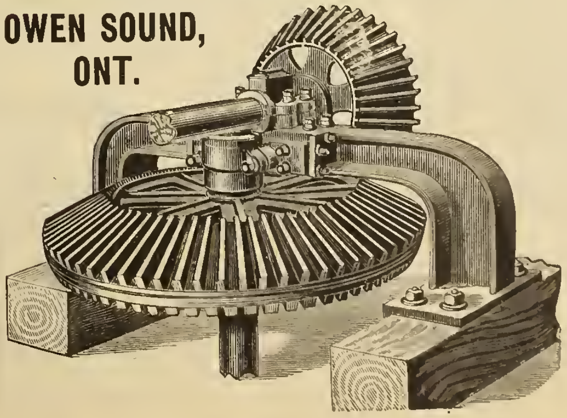

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SPARKS.

At the recent fire at Lakefield, Ont., the Lakefield Electric Light Co. sustained a loss of $3,000 on uninsured property.

Mr. W. S. Andrews has severed his connection with the Canadian General Electric Co., Ltd., at Peterboro', and is about to assume the management of a large electric light concern in Pennsylvania.

Four citizens of the township of Monquager, Amherstburg, have been granted the right of way for an electric street railway to be built at that place.

The manager of the Winnipeg Street Railway Co. has been investigating a new system of motive power combining the elements of the cable and electric service, making overhead wires unnecessary.

The Guelph Gas Co. held its annual meeting recently, Mr. Guthrie, the president, presiding. The business of the company is fairly satisfactory and a dividend of 5½ per cent. for the year has been paid. In connection with their electric works the directors are having fixed a new 1,000 light incandescent dynamo. They have also ordered a power transmission equipment.

The Auer Light Company of Montreal is likely to become extinct. The promoters of the company find they cannot keep their agreement with the shareholders as there is no contract with Dr. Auer, of Viennesse, for a fifteen years supply of the secret fluid from which a brilliant light was to be obtained, and as it can only be procured from him, the business is at a standstill. The company was started with a capital of half a million dollars.

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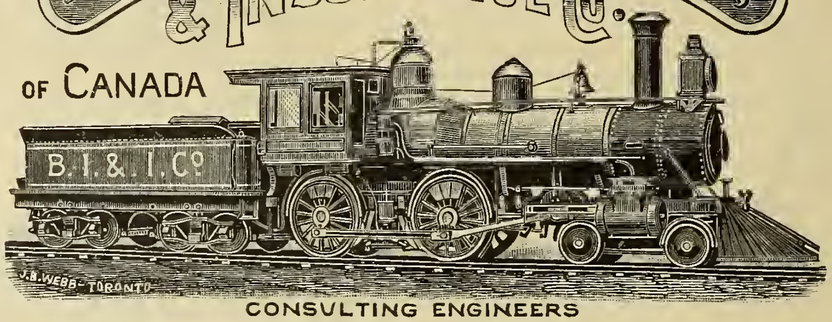

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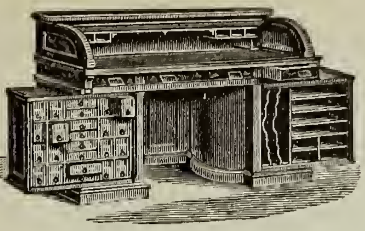
PRESTON,  ONTARIO.

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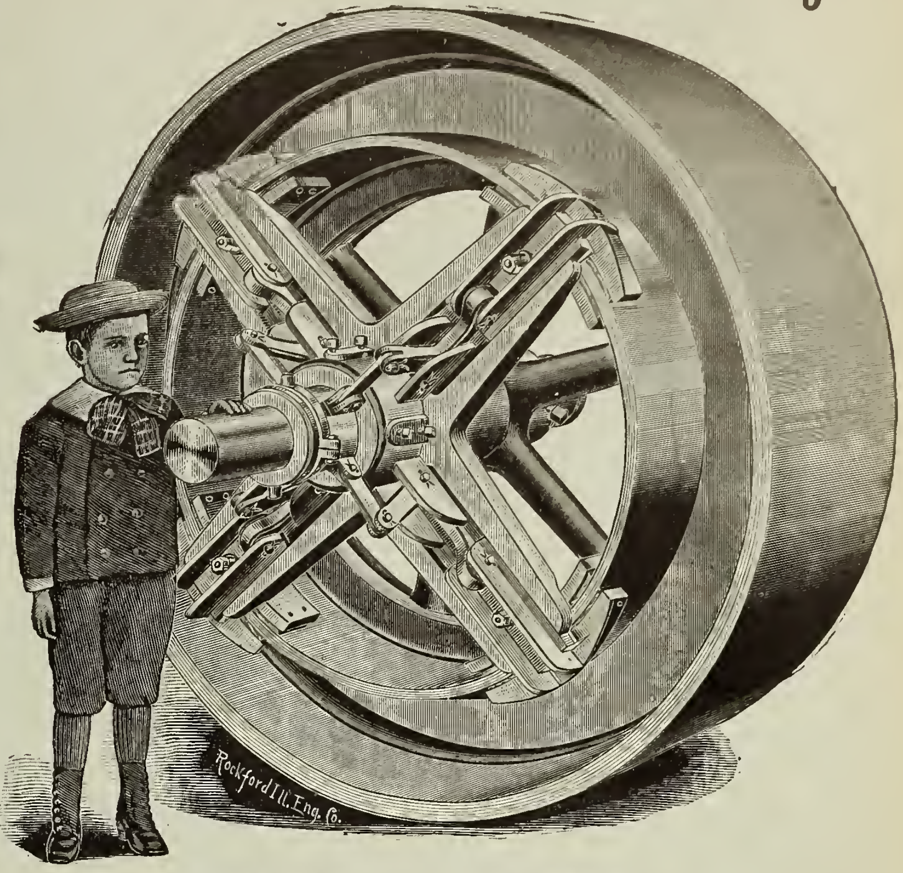
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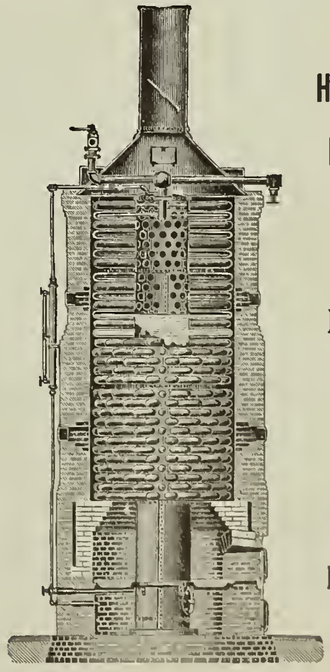

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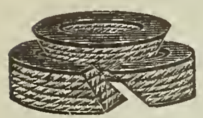

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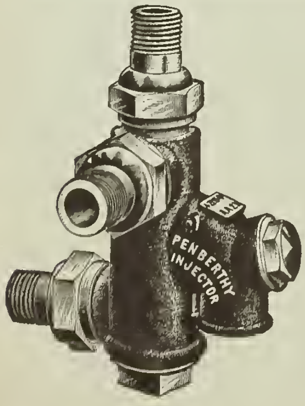

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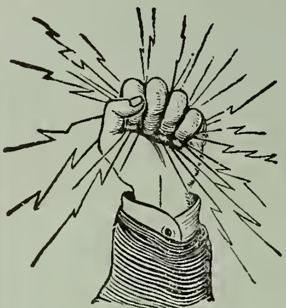

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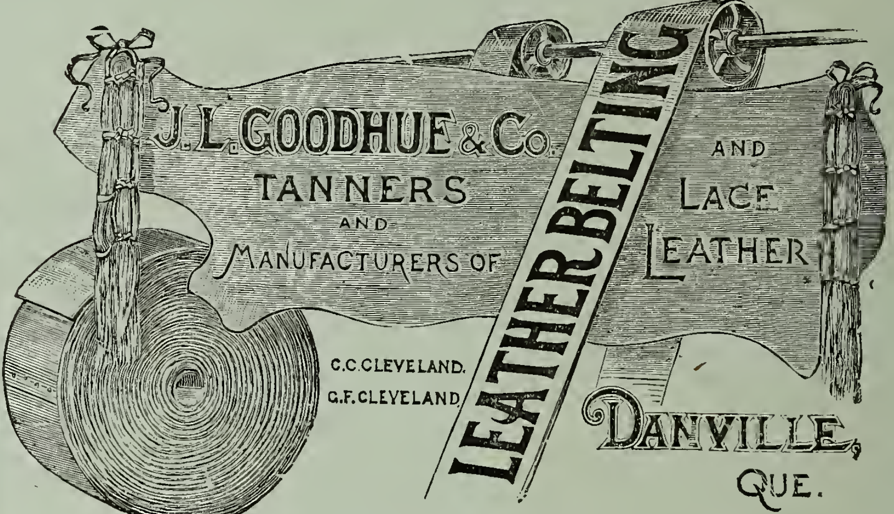

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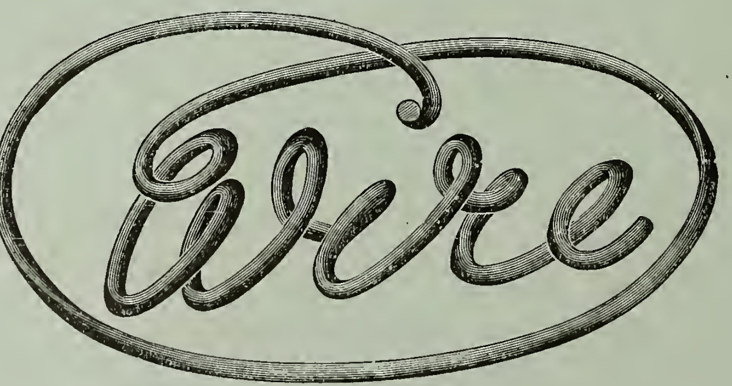

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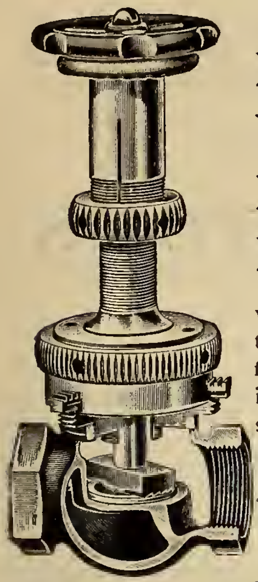

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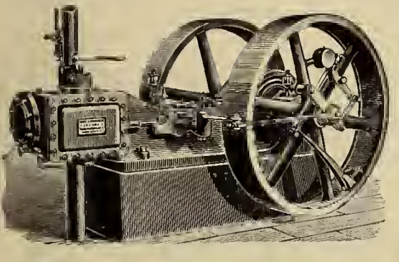

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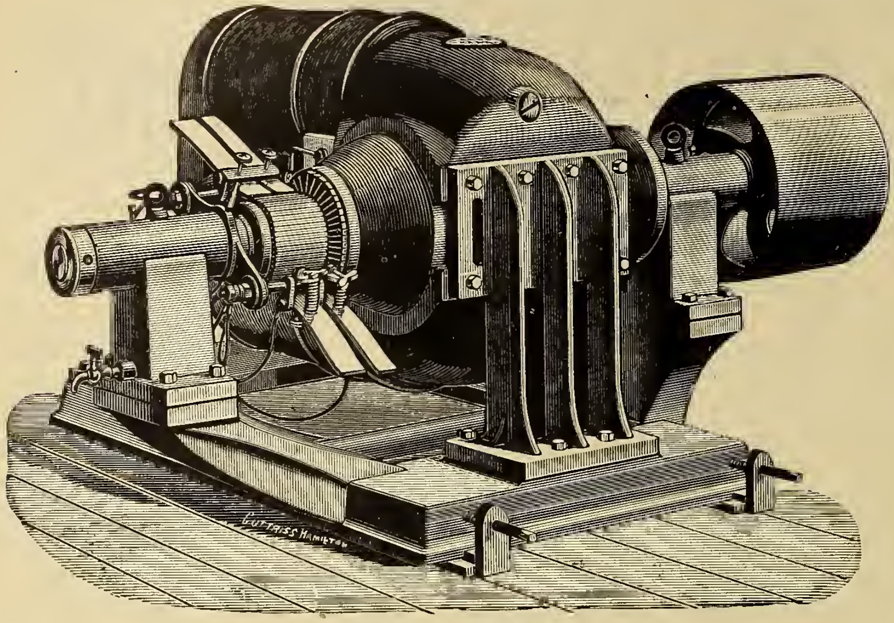

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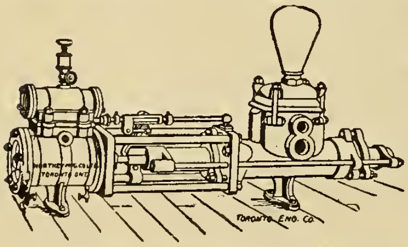

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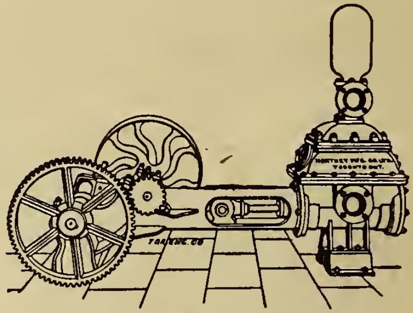

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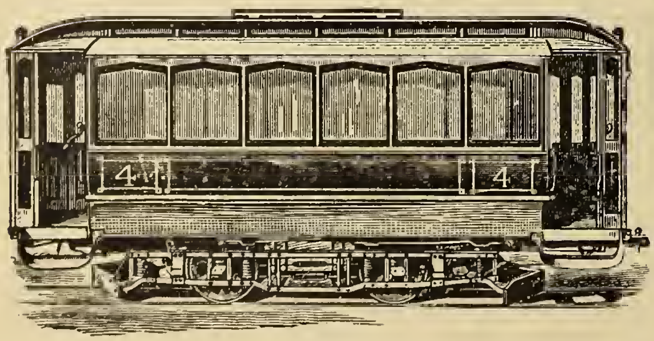

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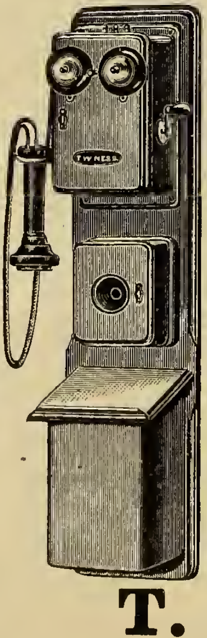

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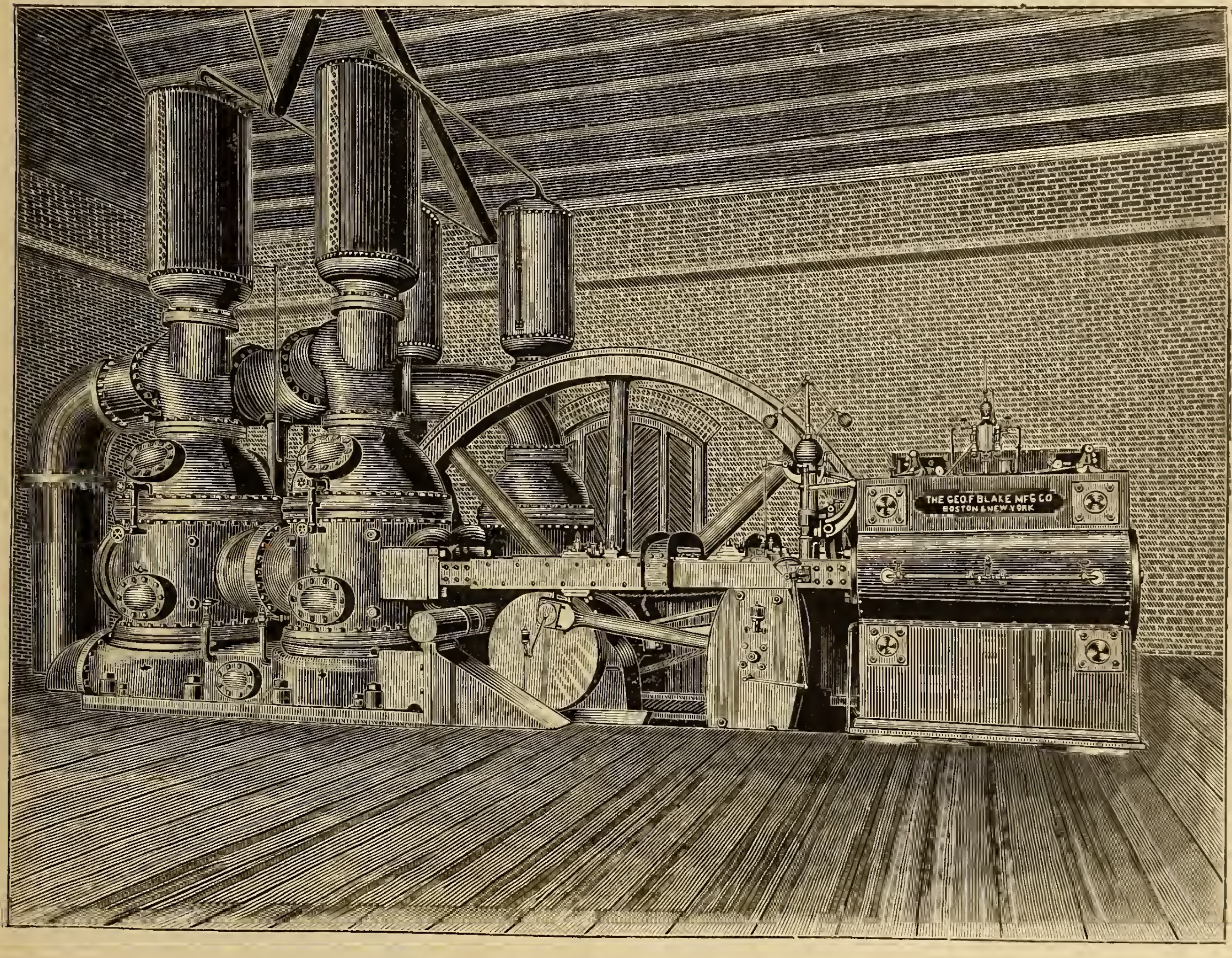
749 Craig Street, MONTREAL.

CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. III. TORONTO AND MONTREAL, CANADA, MAY, 1893. NO. 5.

DUTY TEST OF NEW BLAKE PUMPING ENGINE AT TORONTO WATER WORKS.

THE following particulars taken from the report of Mr. John Galt, C.E., of Toronto, will be found specially interesting and instructive to engineers and others. The report as a whole is a very able one, and reflects credit on Mr. Galt. The perusal of it will repay the student.


THE GEO. F. BLAKE MFG CO
BOSTON & NEW YORK

NEW BLAKE PUMPING ENGINE FOR THE TORONTO WATER-WORKS.

The analysis of the report must be very satisfactory to the city of Toronto and equally gratifying to the designers and builders, The Blake Co., of Boston. We understand that Mr. Keating, City Engineer, has advised the immediate acceptance by the city of the engine, and provision is being made for another similar engine. Although the contract called for a capacity of ten million Imperial gallons in 24 hours, it pumps in excess easily ten per cent. more, giving a duty on an average of 114 million foot pounds for every 100 lbs. of coal burned, equal to a duty of 130 million foot pounds when a similar weight of combustible is considered.

The friction or intermediate resistance of machinery, including air pumps, &c., is less than 20 horse power, thus giving a very high efficiency between the steam cylinders and the pumps. The total driving power of steam cylinders, both high and low pressure, is registered at 612.52 horse power, while the resistance of both double acting pumps converted into horse power registers 594.21.

The duty of the steam engine on a basis of combustible consumed, figures at 136 million foot pounds, which is at the rate of 1.45 lbs. per horse power per hour. This, however, takes the most favorable view. Assuming the actual coal burnt and put in furnaces of boiler to be 50,693 pounds, the duty would fall to something under 120 million foot pounds, and the coal to 1.68 lb. per horse power per hour. It is only fair to note in this connection that the percentage of ash or refuse from the coal is reasonably too high, consequently the commercial standard of engine for coal burnt would be somewhere between 130 and 120 million foot pounds. The reduction, however, of duty to a basis of 100 lbs. of combustible actually consumed, is quite legitimate, and forms a scientific basis for comparative reference of other engines and other performances. The report is quite clear on all these points, and not too elaborate, giving all the essential and necessary deductions on a scientific basis.

Mr. Galt has taken into account, we think wisely, the resistance of the pumps in lifting the water from the well level up through foot valves on suction pipe, also suction and discharge valves, &c. So long as pumps require these, it is absurd to disregard their resistance, which is always taken into account on the discharge side of pumps by the careful readings of pressure gauges and the conversion by calculation at frictional head in feet.

The pump valves, &c., are well designed, and contain large area for the speed run at, and the allowance referred to above tallies exactly with the readings of indicator cards, viz.: 105 lbs.

total average working pressure, which gives an absolute frictional head of 242.22 feet.

During the test of two days everything worked smoothly and well. The engine, which is cross compound, direct acting, with two double acting pumps, appears to be designed on good sound principles, and will doubtless take its place among the best anywhere. The capacity size is a specially good standard, viz.: 10 to 12 million gallons per day, and with perfection of details will come a perfect machine. The illustrations of engine will assist the reader in studying and understanding the machine.

The particulars of the test are as follows:

PRINCIPAL DIMENSIONS OF ENGINE.

STEAM.

4 multitubular boilers 6'x6", with 110 3" tubes, grate surface each	26 ft.
One high pressure steam cylinder, diameter	29 ins.
One low pressure steam cylinder, diameter	58 ins.
Steam piston rods, crank end only, diameter	5½ ins.

WATER.

2 water plungers, double acting, each diameter	20 ins.
Plunger rods, crank end, diameter	4¼ ins.
Length of stroke	48 ins.
Valves, suction and discharge, 64 in each set, diameter.	4 ins.
Effective area of valves, each set	411 sq. ins.
Air pump, single acting, 26" diameter, stroke	12 ins.
Feed pump, 7" diameter, stroke	6 ins.

DATA OBTAINED DURING TEST.

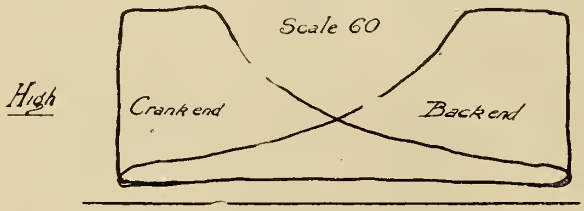
Test began February 16th, 1893, 10:22 a.m. }
Test finished February 18th, 1893, 11:30 a.m. } Duration, 49 hours .08 min.

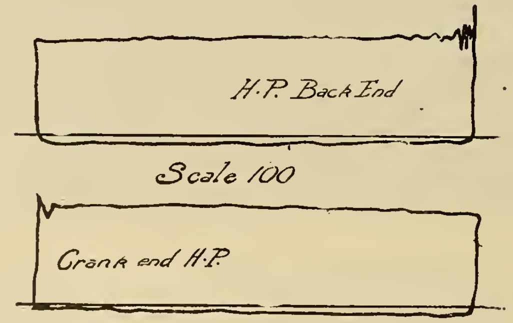
Total revolutions as per counter	112,838
Average revolutions per minute	38.276
Average working per minute	38.288

3 steam boilers only in use:

Total area of fire grate surface	78 sq. ft.
Wood burned in starting fires 700 lbs. =	280 lbs.
Coal put in furnaces during test	50,413 lbs.
Gross total weight	50,693 lbs.
Refuse, ashes, cinder and percentage of unburned coal	6,910 lbs.
Total combustible consumed	43,783 lbs.
Per cent. of refuse	13.6
Coal burned per sq. ft. of fire grate per hour	13 23
Average steam pressure at boilers	117 lbs.
Average steam pressure in engine room	114 lbs.

	M.E.P.	H. P.
High pressure piston, back end, as per cards	48.80	148.96
High pressure piston, crank end, as per cards	47.87	148.60
Low pressure piston, back end, as per cards	13.31	162.51
Low pressure piston, crank end, as per cards	12.60	152.45
Total horse power of steam cylinder		612.52





Average barometric reading	29 703
Average temperature of atmosphere	13.3 F.
Average temperature of boiler room	63.
Average temperature of engine room	70.03
Working length of stroke	47.8 ins.
Average speed of piston and plungers, lineal ft. per min.	304.94
Average working " " " " "	305 ft.
Average pressure on force main at engine house press. gauge	96 lbs.
Average vacuum on suction pipe gauge in ins	9.3 ins.
Vertical dist. of suction pipe below press. gauge	5.5 ft.
Average dist. lift from well meas. to press. gauge	14.91 ft.
Average temperature of water in well	33.3° F.
Average temperature of city mains	35° F.
Average temperature of feed water to boilers	148° F.

	M E.P. Press.	Horse Pr.
Water plunger h. p., side, back end, as per cards	103.40	149.53
Water plunger h. p., side, crank end, as per cards	103.50	142.65
Water plunger, low press., back end, as per cards	106.50	154.55
Water plunger, low press., crank end, as per cards	107.00	147.48
Total horse power for pump plungers		594.21

Friction = 612.52 − 594.21 = 18.31 horse power = 3%.

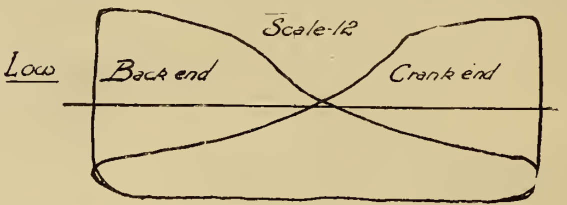
Efficiency of pumping engine 0.79

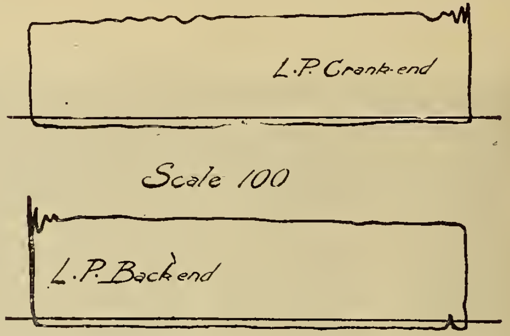
RESULTS.

Imperial gallon, standard vol., Act of Parliament, 1825 =	277.274 c. in.
Imperial gallons in 1 cubic foot	6.2321
Weight of one cubic ft. of water at 35° F.	62.422 lbs.
Weight of one standard gallon	10.061 lbs.
Pumps, theoretical displacement, per rev. $\frac{306.21 \times 191.2}{277.274}$	211.154 gals.

Average revolutions per 24 hours = 55.117.98 = 38.276 revolutions per min.
Working revolutions per 24 hours = 55.134.64 = 38.288 revolutions per min.

Difference due to starting and stopping slowly:
Total water pumped, theoretical displacement ...... 23,826,200 imp. gal.
Capacity of pumps in 24 hours = 211,154 × 55,134.64 × 11,642,000 gallons.
Commercial capacity in 24 hours = 11,642,000 gallons, less 4% .... = 11,176,000 lin. gals.





Duty calculated on different basis:

Average reading of pressure gauge	96 lbs.
Average reading of suction gauge $\frac{9.26 \times 34{,}295}{7000} =$	4.6 lbs.
Average pressure in remainder of suct. pipe, also suct. valves	1.0 lbs.
Average pressure in discharge valves	1.0 lbs.
Add pressure for 5.5 ft. vertical distribution from suction valve gauge to pressure gauge	2.4 lbs.
Average working pressure on plunger as per reads	105 lbs.
Average working pressure on plunger as per cards	105 lbs.
Calculated head resistance $\frac{105 \times 154}{62.422}$ in feet =	242.22 ft.
Duty of engine on coal consumed per 1 horse power per hour $\frac{43{,}783}{49{,}133 \times 612}$	1.45 lbs.
$\frac{33.000 \times 60 \times 100}{1.45}$	136,000,000 lbs
Weight of steam per h. p. per hour, as per indicator cards	13.94 lbs.
Equivalent evaporation at boiler per lb. of combustible consumed under actual conditions $\frac{13.94}{1.45}$	9.8 lbs.
Standard equivalent from and at 212° per lb. of combustible consumed = 9.81 × 1.05	10 30 lbs.

Commercial duty at pump for every 100 lbs. coal put in furnaces:

$$\text{By work } \frac{\overset{\text{area}}{306.21} \times \overset{\text{lbs.}}{105} \times \overset{\text{H.}}{15.94} \times \overset{\text{Rev.}}{112.838} \times 110}{50{,}693} = 114{,}078{,}000 \text{ ft. pounds.}$$

$$\text{By gallons } \frac{23{,}826{,}200 \times 10.0126 + 242.22 \times 100}{50{,}693} = 114{,}031{,}000 \text{ ft. pounds}$$

Commercial duty at pump calculated for every 100 lbs. of combustible consumed

$$\frac{\overset{\text{average}}{114{,}055.000} \times \overset{\text{lbs. coal}}{50{,}693}}{\underset{\text{lbs. combustible.}}{43{,}783}} = 132{,}056{,}000 \text{ ft. pounds.}$$

PUBLICATIONS.

The April *Arena* contains a strong paper by Hamlin Garland on "The Future of Fiction." Dr. Alfred Russell Wallace writes on The Wage-Worker and how he may be delivered from the Social Quagmire. W. D McCrackan discusses "How the Initiative and Referendum may be Introduced into our Government."

Messrs. D. VanNostrand & Co., of New York, have published, in connection with their science series, an interesting little work on the measurement of electric currents. The book, which is illustrated, is made up of two valuable papers, "Electrical Measuring Instruments," by James Swinburn M. Inst. E. E., and "Meters for Electrical Energy," by C. H. Wordingham, Assoc. M. Inst. E. E. The writers deal with their subjects very comprehensively, and the book will be found to be a very useful one.

LEGAL DECISIONS.

AS this issue of the ELECTRICAL NEWS is about to go to press we learn that Chief Justice Galt has quashed the by-laws of the cities of London and St. Thomas granting exclusive privileges to the Bell Telephone Co. The Bell Telephone Co. have appealed from the decision.

EQUIPMENT OF ELECTRIC CARS.*

By E. C. Westcott and E. Craig.

If we cast a glance at the electrical industries in our city six months ago, and compare them with those now existing, we cannot but realize what important and gigantic steps have been made in so limited a time. At that time Montreal employed hundreds of arc lamps, brilliantly illuminating its thoroughfares, while the incandescent lamp could be counted by thousands, lighting residences and stores. Motive power was also then distributed on a limited scale. To these has been added a safe, comfortable and speedy mode of electric transportation.

It is not the aim of this paper to treat all details connected with electric traction, nor even to consider its essential elements. We shall only examine to a certain extent the electric equipment of the cars, making mention of the varying characteristics of the different types to be found in our streets, and the necessary starting and regulating devices pertaining to each system.

The most striking resemblance which characterizes the four different types used, is the laudable practice of imbedding all armature conductors in grooves cut in the armature core for that purpose. Two of the types of motors are so nearly alike as not to need a different treatment, the most striking resemblance being that one is built in Montreal, while the other is a native of Lynn, Mass. Each armature is of the Gramme ring type, the former being wound with ordinary wire and connected to commutator in the usual way. The latter is wound with copper ribbons of such width as to just fill the grooves in which they are placed. A piece of ribbon is fastened by a rivet to the loop between the sections so as to connect same with commutator. These grooves are so shaped that after the winding is finished there is a space left, which is filled with a wooden wedge to keep the ribbon in its place, thus doing away with bands, and affording a better protection to the winding.

The most popular construction is known as the "iron clad," which carries the existing coil on the top pole, thus preventing any moisture which might collect at the bottom of the car, from harming it. The armature and field coil are easily replaced in case of a burn-out. The pole pieces of the former are built up of sheet iron, being placed in the mould before pouring, while in the T and H the pole pieces are cast solid with the yoke. We are informed that a secret process is employed for making the metal in which they are cast.

The Edison motor also has a Gramme armature, differing from the others in that it depends on bands to hold the winding in place.

The winding is done in the usual way, the commutator being cross connected so as to allow of placing the brushes at 90 degrees, in the proper neutral field. It has a four pole field of the iron-clad type, with two field coils placed on opposite poles, and has therefore two consequent poles. The castings are of steel and are made in four pieces, bolted together. These motors are not waterproof, but when covered with canvass which is very easily done, they are very durable.

The last motor which we have to examine is in no respect similar to the others with the exception of the field and armature, which are in grooves. The armature is of the drum type, rotating in a field of four poles. The coils of this armature are wound on taped forms, and afterwards placed in the grooves before mentioned, the ends of same being brought out one section less than 90 degrees apart, instead of the usual style of drum winding. In connecting the commutator, the two ends of each coil are placed in one segment, less than 180° apart. This arrangement has the advantage of having two circuits and overcomes the necessity of having four, and cross connected commutator bars, as in the previous cases was necessary, or there would be an unsafe difference of potential; a cause of trouble, and in doing which there would be no sacrifice of simplicity of construction nor of ease in repairing and replacing damaged coils. In this last case the coils have been wound in a form and then bound with tape before being placed in their respective grooves and it is an easy matter, requiring very little time to remove a number of such coils and if required replace them with new ones.

All of the foregoing motors are series wound, having so many turns that even with a small current they can saturate the field sufficiently to give the armature torque enough to start, even under load. It is a practice with the Edison and T. H. motors, to cut some of the coils after all outside resistance has been short circuited.

The Edison cars in this city have been equipped with the combined rheostat and controller of Thomson-Houston make, being an exception to their general practice of commutating the fields. In order to keep an excessive current from blowing in the motors there must be sufficient counter E. M. F. generated in armatures which is itself dependent on speed and saturation of field; or there must be necessary total resistance provided. If certain devices affecting the necessary field strength changes, are employed, they will prove very beneficial, providing they do not bring such complications as to be sources of trouble. The Edison commutation of fields has a two fold end— while having the property of altering the strength of the field it at the same time alters the total internal resistance of the motor.

The object in view is obtained by winding the coils in sections, (as a rule three, and of an unequal resistance), and having on both platforms a controller in the form of a cylinder on which a certain number of brass pieces have been fastened in such position and of such shape that rotation of cylinder brings these peculiar shaped pieces under the different stationary contacts to which the individual terminals have been brought.

The position of cylinder will cause the circuit to be completed through one of the following combinations, that is: three coils in series with an indispensable outside resistance; the coils in series and rheostat short circuited; leaving two only in circuit, the coil just short circuited placed in shunt to one out of the series; the last coil of the series short circuited; and lastly, the last named coil placed in multiple with the other two. But the advantages of such a devised system lead to a great complication of wiring and introduces the reasonability of making field coils cores a place to build the rheostat.

In the T. and H. system, the motors are controlled with one controller and are connected with controller's handles at both ends of the car by means of steel cable threaded through pulley sheaves. Although the rheostat and controller are combined in one, saving a large amount of wire which would have to be used otherwise, yet the advantages pertaining to having an independent controller at each end more than compensate for the saving of wire in the fact that it is almost impossible for both controllers to break down at once.

The Westinghouse rheostat is made of spiralled wire divided into five sections, five contacts being placed on rheostat box in such a position as to be easily accessible for connecting the wires from controllers. The controller consists of a cylinder having six brass pieces of varying length attached, which are for cutting in and out the rheostat sections. The longer of these makes contact with the first section of the rheostat on turning the cylinder, the rest following according to their length. The reversing switch is placed on the same cylinder, consisting of six contacts, two of which make contact with the ground field respectively, the other four being cross connected in such a manner as to reverse the current in the armature, the direction of which is determined by the direction in which the cylinder is moved, the controller contacts acting the same in either direction.

The greatest troubles that have been experienced with the cars, are the giving out of armatures and field coils, which are traceable in the majority of cases to the most unfavorable conditions to which they are subjected. It is certainly not the purpose of electric machinery to be run in water, but many a day this is almost the case. The best remedy is unquestionably to replace the damaged part, but to prevent the trouble is rather more difficult, although judging by what one reads in periodicals regarding receipts for overcoming moisture and water-proof paints, preventives seem to be within reach. If such paint were obtainable, and the design of motors was such as to admit of all wire being out of the reach of water, care being taken to keep the car from wide differences of temperature, it would certainly help a great deal and save a great number of burn-outs. The fact that the series wound motor is being used in almost all cases, in preference to the shunt motor so successful in stationary work, may lead to questions regarding the reasons of such practice. Perhaps the unreliability of the supply reaching the machinery through the dirty rails and the shivering trolley may account for it to a certain extent, as every time that the circuit is opened, the field will lose its saturation. An armature without counter E. M. F. is practically a short circuit, but this could certainly be obviated without much complication by having automatic devices in the armature circuit which would let current flow only as long as the field was saturated. Another consideration very objectionable, is that of having 500 volts of pressure between the terminals of the field coils. Also with the cars the constancy of speed being of no consideration and impossible the great advantage of shunt motors would be lost.

There is good reason to think that in the near future the alternating motor of single phase will be made self starting and of sufficiently powerful torque to make it adaptable for traction purposes. When that has been realized, the ideal will be reached, for the armature of the motor would be merely a number of copper bars not necessarily insulated from the core, and all short circuited at the ends on flanges and without a commutator, while all the regulating devices required would be the reactive coil, not even reversing switches being needed. Trolley cars will not then require a higher pressure than 100 volts.

Owing to advantages to be secured by the use of transformers, currents can be generated at distant points where power may be had for a minimum cost, but this is not very important when we remember that the fuel expense is no more than 10% or 15% of the total expenditure.

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* Paper read before the Montreal Electric Club.

CORRECTION.

The Doty Engine Co. advise us that they constructed the breeching in connection with the power plant at the Toronto Street Railway Company's power house, and not Mr. John Abell, as stated in our last issue. The error was due to our having been mis-informed. We take pleasure in now placing the credit for this excellent piece of work where it properly belongs.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of the various Associations are requested to forward us matter for publication in this Department before the 20th of each month.

ADVICE TO YOUNG ENGINEERS.

(By Bro. W. J. Rhodes, Pres. Berlin No. 9, C. A. S. E.)

For about twelve years I have been learning my trade,
And don't claim to know it all yet;
But have learned a few things by the blunders I've made
That I'll not very soon forget.

Experience is a good, though very dear school,
But we needn't all learn things that way—
From books and good papers we may learn some good rules,
And will have less tuition to pay.

While speaking of rules, let me give you just one
On which you can always depend:
In steam engineering the less risk you run,
The better you'll come out at the end.

You may oft hear it said, "no risk no gain,"
But it won't do to risk much with steam,
For it's risky enough; so be sure of your run,
As you would with a runaway team.

Don't run any risk. If your pump doesn't throw,
Stop, while you have water in sight..
The boiler *may* stand it, but that you don't know,
It may blow you as high as a kite.

Men often gain time by just going slow,
But many dear lives have been lost
By going by guess, when facts they should know
Could be had at a trifle of cost.

Now just one thing more! when your day's work is done,
Before from the boiler house you retire,
If with water and steam no risk you have run
Be sure you run none with the fire.

Don't run any risk, boys, unless
It's with something you can't make secure,
Don't do any work by the rule of "I guess,"
When the facts you can easy procure.

Have some little pride as to how your place looks,
And whatever you do, do it right—
Have plenty of tools and plenty of books,
And don't run around much at night.

And now my dear boys, of all that I've said
I hope you'll remember the text,
Don't run any risk, and you'll come out ahead;
I'll tell you the rest in my next.

ORGANIZATION OF BERLIN ASSOCIATION NO. 9.

AT a preliminary meeting of stationary engineers held in Berlin, Ont., April 8th, it was decided to organize a branch of the C. A. S. E. on Saturday, April 22nd. This decision was the result of some missionary work done by Bro. John A. Angell, District Deputy and President of Guelph No. 6, who was assisted in the work in a most able manner by Bro. W. J. Rhodes and several other engineers of Berlin.

Bro. Angell had applied to the Executive Council for, and had received the charter for the new Association, (which will be known as Berlin No. 9, C. A. S. E.) and had instructions to proceed with the organization, but unfortunately a few days previous to the day appointed, was taken very ill and thus was unable to finish the work he had so well begun.

The news of Bro. Angell's illness was communicated to A. E. Edkins, President of the Executive Council, with the request that he should visit Berlin and complete the work of organization, which he did, being accompanied by Bros Jordan, Green and Tuck, of Guelph No. 6.

On arriving at Berlin the visitors were met by Messrs. W. J. Rhodes, A. Vice and Geo. Steinmetz, who conducted them to the Commercial hotel.

At 8 o'clock the engineers interested began to arrive, and at 8.30 the meeting was opened by Bro. Edkins, who was requested to lay before those present the objects of the Association. This he did in a brief speech, laying particular stress on the need of such an organization in every manufacturing town in Canada, as it would not only prove beneficial to the engineers, but even more so to the steam users. By raising the standard of the engineering knowledge of its members, it would certainly follow as a natural result, that the employer's plant would be kept in a greater state of efficiency. Steam users, he said, were prejudiced against the Association at first, but the majority of them now appreciated its work. There were some engineers even, who were, as they themselves put it, "down on the Association." Some of these men were good engineers and mechanics, who would be a credit to the organization, but who for some reason or other, had formed a wrong impression of it. Then there was another class who, when asked to become members, would inform you, with a deal of wind and blow, that they know all they *want* to know of engineering, and therefore could not learn anything themselves by joining the Association, and were certainly not going to come up to the meetings and tell all they had learned during their long and varied experience.. If the truth were known, this class of men would gladly become members, but for the fact that they are fearful lest they should be asked for information on some subject, which they could not give, and that would make them appear ridiculous in view of their previous boasting. It was a pity that men acted in this manner, for the chief object of the Association was to assist its members to become better engineers. He hoped the day would never come when they would "know it all." The election and installation of officers was then proceeded with, and resulted as follows:—

President, W. J. Rhodes; Vice-Pres., Alf. Vice; Rec. Sec. Geo. Steinmetz, Berlin post office, Ont.; Treasurer, Henry Snider; Fin.-Sec., John Fennell; Conductor, Abram McKessie; Doorkeeper, Wm. Fiedt.

About 15 charter members were initiated, and several other engineers have signified their intention of joining.

A vote of thanks was presented to the brethren from Guelph and Toronto for their kindness in being present, and the hope was expressed that Bro. J. Angell might be speedily restored to health, and be enabled to visit No. 9 in the near future.

ANNUAL DINNER OF HAMILTON NO. 6.

The above Association held their sixth annual dinner on Thursday, 30th March, at the Commercial hotel. About 100 of the members and their friends surrounded the tables in the fine dining room of the hotel, and were well pleased with the delicacies which mine host Maxey and his staff of waiters placed before them.

The chair was occupied by Bro. Wm. Sweet, President of the Association, and the vice-chairs by Bros. W. Norris and A. Nash. On the removal of the cloth the chairman welcomed the members and guests on the occasion of their annual reunion, and bespoke for all a pleasant time. He then proposed the toast of the "Queen and Royal Family," to which the company responded by singing heartily the National Anthem.

The "Army and Navy" brought forth a response from Bro. Thomas Carter, a veteran.

Mr. H. N. Thomas sang "The Longshoreman," and received such a hearty encore that he favored the company with "Hearts of Oak."

"The Dominion Parliament" was responded to by Mr. Jas. Weir, of the Inland Revenue Department. The speaker claimed that Canadians had at Ottawa representatives who could hold their own in point of ability with any in the world.

Prof. Cline sang "The Maple Leaf."

"The Ontario Legislature" was received with loud applause. Brother Duncan Robertson responded. He expressed regret that the Hon. J. M. Gibson, at the last moment, had been prevented from being present. He was sure that that gentleman would be gratified if he knew the kindly feelings which the engineers cherished towards him for services rendered the Association. Not only the members but the community at large owed the Hon. Mr. Gibson and the Ontario Government a debt of gratitude in this connection.

Mr. Thomas Jones sang "Farmer Magee."

"The Electrical Engineers" was responded to by Mr. Wells. Prof. Cline sang "The Old Red Cradle." "The Mayor and Corporation" was ably responded to by Ald. A. D. Stewart. He referred to the importance of the Association of Stationary Engineers, a body of skilled artisans, without whose services the public would fare badly. The toast to the "Manufacturers" was replied to briefly by Mr. McKeown, followed by a song "Cockles and Mussels," by Ald. Stewart.

"The Press" was acknowledged by Mr. Buchanan, of the *Times*.

Mr. Thomas James sang a comic song.

"The Canadian Association of Stationary Engineers" was responded to by Bro. A. M. Wickens. He said he was proud of the organization, and there were a great many reasons why he was proud of it. He referred to the brainy men who had been engineers in Canada in the past, one of whom had built the first steamship to cross the Atlantic, and it was constructed of Canadian materials, too. He mentioned the names of Edison and Bell, Canadians who had distinguished themselves in engineering science; and there were many others as well. A little over six years ago the Association had been founded in the speaker's dining room in the city of Toronto, when there were just eleven men present. Now a chain of branches extended from Ottawa to Winnipeg. All of these were doing good work.

"Prof. Cline sang the "Cameron Men."

"Our Sister Associations" was responded to by Messrs. Wier and Bates. Both reported that the Association in Stratford was flourishing and the demand for men holding certificates was increasing.

Mr. Thomas Lewis of the rolling mills, dropped in and favored the company with a couple of his inimitable songs.

"The Honorary Members" was responded to by Bro. Duncan Robinson.

Songs were sung by Messrs. P. Casey and J. Church. Bros. Langton and Johnson responded on behalf of "The Ladies."

"Our Host" was acknowledged in a neat speech by Mr. Maxey.

After one or two volunteer toasts, and the singing of a few more songs, the merry evening was brought to a close with "Auld Lang Syne" and "God Save the Queen." Mr. Thomas Baine played the accompaniments for the several singers during the evening in a very acceptable manner.

Toronto No. 1 held its regular meeting on April 14th, W. G. Blackgrove, president, in the chair. Mr. Edkins read a portion of Desmond's Electricity and a general discussion followed. There was an exceptionally large attendance of members. Three new candidates were initiated and one proposal received. The officers for this Association for the ensuing year are to be elected on June 23rd next.

Guelph No. 6 met on the 15th ult. The President read a paper on "Lining up an Engine," which was great appreciated by the large number of members present. One new candidate was initiated.

Mr. W. G Blackgrove, Secretary of the Executive Council, has removed from 43 to 45 Brant street.

QUESTIONS AND ANSWERS.

Member C. A. S. E., Guelph, asks :—

1. Does the fly wheel increase the working power of an engine?

2. Will the drive wheel have the same effect on the engine as an idle fly wheel of equal weight and diameter?

3. If raising a safety valve will cause water to leave the bottom of the boiler, what effect will blowing the whistle have?

Ans.—1. A fly wheel does not increase the working power of an engine. It acts as a reservoir of power. Power accumulates in it as its speed increases and is given off by it as its speed diminishes.

2. A drive wheel will act efficiently as a fly wheel if made heavy enough and of sufficient diameter.

3. Raising a safety valve allows *some* steam to escape, and so does blowing the whistle. If letting some steam escape from a boiler raises the water off the bottom of the boiler how is it that a steam engine can be run in connection with a boiler? Every time the engine valve opens some steam escapes from the boiler, and according to the supposition in the question the water ought to go too! Does it?

H. F. Thompson, Recording Secretary Montreal No. 1, C. A. S. E., asks :—

What qualifications must a man have to permit him to write after his name the letters M. E., and also the letters E. E.? M. E., in this case, stands for Mechanical Engineer, and E. E. for Electrical Engineer.

Ans.—The letters M. E., standing for Mechanical Engineer, may in this country be appended to any man's name who thinks himself entitled to use them. The same with the letters E. E., standing for Electrical Engineer. So far as we know, the law of the land takes no cognizance of these letters as it does of M. D. and sundry others, and till the law defines who alone may use them, every one who meddles with engines may call himself an M. E., and every egotistical idiot may write E. E. after his name if he can.

THE COMPLAINT OF A MOTORMAN.

Toronto, April 4th, 1893.

Editor Electrical News.

Sir: I am employed by the Toronto Railway Co., as motorman, and have been a very diligent student of electricity as a motive power since its introduction in this city. The company will not even allow us, however, to replace the plugs, when they are blown, but we have to wait for the next car to push us to the shop, causing worry and delay to passengers as well as motormen. There are men employed by the company, calling themselves "inspectors,"—men who worked in the shop for probably three months, and who have the audacity to rank themselves with experts, but who in reality do not know the first rudiments of the work they are engaged in. These men and the roadmaster (who probably never ran more than three trips on an electric car) are only allowed to replace the plugs or do other temporary repairs, while motormen, who have been driving motor cars since their introduction, and know the different causes of obstruction, are unable to use their knowledge. I give you an illustration which happened to me about two weeks ago: I was training a man to run a motor, and among other things took up the floor to show him one of the machines and explain to him the different wires on the motor board as well as my scant knowledge would permit, when one of our lordly "inspectors" swooped down on me and asked me any right to interfere in his business. I told him very politely but firmly that although I would not interfere with the machine in his charge, I would take up the floor as often as I liked for my instruction as well as for the information of those under my guidance. Is not this amusing? If this letter could meet the eye of some of the officials, which I hope it will, I would respectfully submit the following for their consideration:

1. To employ only the most intelligent men as motormen.

2. To authorize six mortormen on each line to make temporary repairs in passing obstructed cars; this will do away with inspectors who, like policemen, are never to be found when wanted.

3. In course of time every motorman will be his own inspector. This would reduce expenses and would increase the efficiency of the service 80%. Until such time as some such course as this is adopted all the information we could gain from your instructive paper would be useless so far as its practical application is concerned.

In a discussion among motormen, last Saturday, as to the merits of your paper they were favourably impressed with its contents, but emphatically refuse to subscribe until the company's mode of procedure is reversed, the motormen treated as intelligent men shuold be, not as block-heads.

Respectfully yours,
Howard W. Stanley,
Motorman Toronto Ry. Co.

HAMILTON.

(Correspondence of the Electrical News.)

This little city will be the scene of great activity very shortly in an electrical way, for in spite of the assurance of the managers of the Hamilton Street Railway Co. that their old rails would do them a couple of years longer, they now find that they must all be renewed, which will involve an outlay of many thousand dollars, but they will save in the end, because the rails now are pounding the life out of their motors in more ways than one. They have also made a start at a cross town road to run to the G. T. Railway station, and have commenced grading and tracking a mile and a half extension to the new fair grounds and race track. They are having several new cars built with which to equip these extensions, and are putting in a new Corliss engine and Westinghouse generator for the same purpose.

You have perhaps heard of our little extravaganza here in the shape of "Ye Olde English Fayre" which came off in the drill hall, and in which was installed by the Hamilton Electric Light Co., some 11 arc and 100 incandescent lights. It was well patronized and enjoyed thoroughly, and is something to be remembered in more ways than one, but from an electrical point of view, particularly, as our friend Cochrane, the well known photographer, with his usual vim and push, had a full fledged photograph gallery rigged up and did a rushing business, even at night time, with four 2000 c. p. arcs to take the place of daylight. The work turned out was excellent, and as good as any produced by daylight. It was quite a novelty and took well.

I must also tell you that one of our enterprising grocers is now serving out as samples, pan cakes cooked on a little electric griddle, and they are perfection as far as the cooking is concerned.

The Hon. Senator Sanford has some 300 incandescent lights in his private residence in this city.

John Calder & Co., wholesale clothiers, have just had 136 incandescent lights put in their establishment, together with an electric motor to operate their elevator.

There is some talk of installing an arc light plant at the Beach this summer to light the hotels and a summer theatre which it is proposed to erect there, and perhaps the road for a mile or so.

We had a call from our genial friend, Mr. D. A. Starr, of the Royal Electric Co., Montreal, who it is perhaps needless to say, shines as bright as ever. Mr. C. W. Henderson, the electrical supply man, of Montreal, also gave us a call a few days ago, and is up to the neck in business. He took away one or two orders with him, and is pleased in consequence.

The Eagle Knitting Co. have placed an order for a 10 h. p. motor to operate their works, employing some 200 hands.

Electri-Cus.

The Bell Telephone Co. have obtained an exclusive ten years' franchise at Ottawa for $1,500 a year.

CANADIAN
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ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 25th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 22nd day of the month.

SUBSCRIPTIONS.

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Subscribers may have the mailing address changed as often as desired. *When ordering change, always give the old as well as the new address.*

The Publisher should be notified of the failure of subscribers to receive their papers promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

THE "CANADIAN ELECTRICAL NEWS" HAS BEEN APPOINTED THE OFFICIAL PAPER OF THE CANADIAN ELECTRICAL ASSOCIATION.

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BRANDON, MAN., BRANCH NO. 1.—Meets 1st and 3rd Friday each month, in City Hall. A. R. Crawford, President; Arthur Fleming, Secretary.

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GUELPH BRANCH NO. 6.—Meets 1st and 3rd Saturday each month at 7:30 p.m. J. A. Angell, President; C. Jorden, Secretary.

OTTAWA BRANCH, NO. 7.—Meets 2nd and 4th Tuesday, each month, in Labour Hall. J. H. Thompson, President; J. B. Latour, Secretary.

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KINGSTON, ASSOCIATION STATIONARY ENGINEERS.—Meets twice each month over No. 1 Fire Station. J. Devlin, President: W. Gilmour, P. O. Box 699, Secretary.

IT is gratifying to us to observe that the invitation which was recently extended through these columns to engineers to ask for information through the "Question and Answer" department of this journal is being responded to. Several answers to questions thus submitted are published in the present issue, and we would be pleased to see the number increase. In this way much valuable information may be disseminated. We would be pleased if our readers would not only ask for needed information, but also when possible supplement our answers by any additional information on the subject which they may be in possession of.

THE Executive Committee of the Canadian Electrical Association is taking time by the forelock in regard to the arrangements for the second annual meeting to be held in Toronto next September. The promises of several papers for that occasion have already been secured from members of recognized ability. It is expected that the full number of papers required will very shortly be arranged for and be in course of preparation. A meeting of the Executive Committee will be held on the 17th inst. for the purpose of forwarding this and other arrangements for the convention, which it is expected and believed will surpass in attendance and interest any that has yet been held. Every member of the Association is urged to endeavor to increase the membership, and in every possible way to assist its progress and practical usefulness.

THE members of Toronto No. 1, C. A. S. E., have introduced an interesting feature in their meetings. They have taken up for study and discussion Electricity. A member reads a chapter from an authority on the subject, after which the question is discussed in all its bearings by the members. This practice should be the means of making the gatherings of the association more attractive, while affording opportunities to the members to become acquainted with a subject which, next to that of steam engineering itself, applies most closely to their calling, and exerts the greatest influence upon their material interests. The fact is becoming increasingly apparent that the engineer who neglects the study of electricity will soon find himself placed at a serious disadvantage as regards ability to obtain and hold the best positions.

WE learn that active preparations have already been commenced by the engineers of Montreal for the annual convention of the Canadian Association of Stationary Engineers which is to be held in that city early in the autumn. The Montreal City Council has granted $300 toward the cost of entertaining the visiting delegates, and has also given the free use of the City Council Chamber for the meetings. It is expected that the manufacturing firms of the city will contribute liberally for the purpose of making the occasion one of much pleasure and interest. It is hoped that liberal arrangements can be made with the railroad companies, such as will enable a large number of members from the western cities to attend. Perhaps the best arrangement would be for the Association to charter a car for the use of these members, as many as possible of whom will go if the rates are reasonable. At this convention a number of papers of much interest to engineers will be read and discussed. Everything points to a successful meeting.

IN our correspondence column we publish a communication received from a motorman in the employ of the Toronto Street Railway Company, complaining of a grievance existing among his fellow workmen. At an interview with an official of the company in reference to this letter, we were given to understand that it is their intention to encourage among their motor men the study of electricity as a motive power, and how this can best be done is to be considered at an early meeting of the directors. Our correspondent must bear in mind that when the motor cars were first run on the streets in Toronto it was necessary to have regulations of the nature he mentions in order to prevent incompetent men from interfering with the machinery or else import experienced men from places where cars had been running for some time, in other words American labour would have had to be resorted to. There is no doubt that it is to the company's interest to satisfy this desire for knowledge among the motormen in their employ. THE ELECTRICAL NEWS would be pleased if in any way through its columns the object sought might be promoted.

THE list of new subscribers to THE ELECTRICAL NEWS during the present year is gratifyingly large. About two hundred new names have been received since the first of January, and these have come from all parts of the Dominion. Such a liberal measure of appreciation will stimulate us to raise the standard of the paper's interest and usefulness to the highest possible degree. There are three ways in which we would be pleased to have the assistance of every reader: 1. Endeavor to send us at least one new subscriber each year. 2. Contribute as frequently as possible information to our columns. 3. When in need of electric or engineering supplies, consult our advertising pages, write our advertisers for what you require, and when doing so mention the fact that you saw their advertisement in the ELECTRICAL NEWS. If you do not find advertised what you require, write us to that effect, and we will immediately put you in the way of getting it. It need scarcely be added that considering the widely extended and rapidly extending subscription list enjoyed by the ELECTRICAL NEWS among users of electric and engineering appliances, the makers of such articles need not hesitate in deciding how they may most directly and cheaply reach these classes.

THE city council of Montreal are threatened with litigation over their telephone communication by the new Merchants' Telephone Company who are insisting upon the city council granting them the privilege to erect poles on the streets. The company maintain that according to their charter, they have the right to do this in any city in the province. They declare their intention should the city refuse their application to carry the matter into the courts. The difficulty the council find in granting this request is that the Bell Telephone Company refuse to continue the work of placing their wires underground according to their charter until the council pass a resolution permanently prohibiting the erection of poles in the city by other telephone companies. This step of the Bell Telephone Company is we think perfectly justifiable, for they have already expended nearly $40,000 in underground work, and it will cost yet a large sum before the work is completed. Why should they be put to this expense in order to make room for poles to be fixed in the street by another company who would, by this means, be able to enter into competition with wires laid at one seventh the cost of underground work. It appears strange that a company should be given a franchise to put up poles in the streets of any city in the Province without giving the municipal authorities power to prevent such work if they should deem it desirable to do so.

DURING the last year the development of electric railways in Canada has been exceedingly rapid. One new enterprise of this character has crowded so fast upon another that there have usually been from half a dozen to a dozen roads under construction at the same time. The efficiency and economy of the trolley system has been so clearly demonstrated that little difficulty is now experienced in securing the necessary capital for the construction and equipment of new roads where the conditions are such as to make it reasonably certain that sufficient business can be developed to pay a fair return upon the capital invested. In fact, judging from the number of new roads, and the reputation for sound judgment of many of the persons who are embarking their capital therein, electric railways have come to be regarded as being amongst the safest and most desirable business investments. Electric railroad development is said to be more rapid proportionately in Canada than in the United States, notwithstanding the speedy revolution which has taken place in this direction on the other side of the line. Nor is there at present any prospect that the rate of progress in this country will in the near future decrease. The fact is becoming apparent that in the case of suburban roads it will not be necessary to look to passenger traffic alone to provide the necessary returns, but that a profitable business may also be done in the carrying of light freight. This fact will doubtless lead to the extension of such roads into the rural districts and to their use by farmers instead of the familiar two-horse waggon, which in the present stage of perfection of country roads, is a slow and costly method of conveying produce to market.

THE Railway Committee of the Privy Council have amended their order passed in September last, under which the City and Suburban Electric Railway Company of Toronto Junction were held liable for the entire cost of protecting the crossings with the Grand Trunk Railway on the Davenport Road and the Canadian Pacific and Grand Trunk railways on St. Clair avenue. The committee now order the cost of maintenance to be apportioned as follows: The cost of protecting St. Clair avenue crossing is to be borne, one-half by the electric railway, one-quarter by Toronto Junction, two-thirds of the remainder by the G. T. R., and one-third by the C. P. R. The electric railway will bear one half of the expense of the Davenport road crossing, Toronto Junction and the G. T. R., one quarter each. The cost of protecting both crossings would be about $2,000 per year. This is not only a question affecting the company running the cars at the present time, but the public, as the franchise of an electric railway is made less valuable when the whole cost of maintaining such crossings is thus imposed upon street railway companies. It must also be remembered that the parties who maintain the crossings, will also be held liable for improvements, such as the building of bridges, &c., should the traffic on the road increase to such an extent as to make these necessary. While this question of crossing tracks has been agreeably settled in the north-west of the city with a new street railway company, it is surprising that a difficulty should have taken place between the G. T. R. and the Toronto Street Railway Company in reference to the crossings at the Don. This latter company is of long standing and its right of crossings, which has been exercised for years, has never been suspended. True, it has been held that street cars come under the Railway Acts when they are propelled by electricity, but surely the law never intended that when an old company by this means placed itself under these Acts, it should forfeit its prior existing rights to cross railways. Such legislation to our mind would be as unjust as to saddle the City and Suburban Railway Company with the entire cost of maintaining the crossings already referred to. The crossing no doubt needs better protecting, which could be done by the erection of gates similar to those described elsewhere, and the Street Railway Co. should have no difficulty in arranging with the G. T. R. and the city regarding the terms upon which it should be carried out and maintained.

ENGINES FOR ELECTRIC LIGHTING.

IV.

One of the largest and at the same time most complete and most successful systems of power transmission is to be found in Paris, France. It was originally designed to supply compressed air for the regulation of clocks, and four years ago 8000 clocks were connected with the system. It is now the largest compressed air system in Europe.

The company has four central stations; three of these have each two thousand horse power, and the fourth has machinery for eight thousand horse power, and is laid out to contain machinery capable of supplying twenty-four thousand horse power.

The air is compressed by means of steam engines, and is distributed under a high pressure in mains and used to drive engines, instead of steam, and for other purposes. In some of the earlier appliances about 50% to 54% of the power developed at the station was utilized in the engines of the consumers. Later improvements have been effected so that 80% and over has actually been made use of.

In the new large station the steam engines used are triple expansion vertical engines using about 1½ pounds of coal per horse power per hour.

The air is delivered at a pressure of 60 lbs. per square inch, and is in some cases made to pass through a heating arrangement before being used in the engine.

This system of using air for distributing motive power has many points in its favour, and will prove a strong competitor with electricity. The pipes conveying the air are made in lengths of about 9 feet with flanges and joints made with India rubber. The loss from leakage is very slight. When power is required for lighting purposes an air driven engine may be used to run an electric dynamo and so produce electric light.

Another method of power distribution which has very much to commend it has been long in partial use. The distribution of gas as a fuel and its use in gas engines for the production of power will yet be much more extensively employed than it ever has been. There are no serious difficulties in its manufacture, storage, distribution and use. It can at once be applied for power, light or heat and can be carried long distances with very little loss, and used with safety even by unskillful persons.

Gas engines are now made of all sizes, from one horse power up to over two hundred horse power. The quantity of gas used in the first commercially successful gas engine was from 20 to 25 cubic feet of coal gas per horse power per hour, in engines of even small size, that is under 40 horse power. Reduced to a coal consumption, these engines have been run as low as one and one-tenth pound of coal per horse power per hour. Within the last few years improvements have been made, making the gas engine a much more perfect machine than it was, and it bids fair to be a formidable rival to the steam engine.

The use of gas as a means of distributing power has probably more to commend it than any of the schemes considered. By it engines may be driven and light and power distributed by electricity as so many are now doing by steam When the demand for more power comes, another engine can be at once started without any preliminary getting up of steam. When the demand ceases, the engine can be stopped without any loss from leaving boilers with steam up and fires burning.

The convenience of working the power at distributing stations is at once apparent, and as fuel gas can be made more cheaply than illuminating gas and can be used in the engines, the economy will be found by all who will try it.

Another advantage in such a system would be that many customers could be found who did not want either power or light, but would take the gas for cooking and heating purposes. In some places there would be a difficulty in getting such works started owing to the existence of illuminating gas companies having chartered rights as to the laying of pipes under the streets and such like privileges, but in other growing towns where there are no gas companies there would be less difficulty, and once the great advantages of the system were put into practical use the way would be opened up in large cities.

AUTOMATIC TELEPHONES.

It is as much an open question now as it ever was in the days of the immortal Shakespeare, whether it is not better to "bear the ills we have" than "fly to others that we know not of." It is perhaps ungallant to speak of the long suffering and usually patient "hello girl" as a cross to be borne with Christian resignation, but the stern and solemn fact remains, that if you ring your bell too much in her ear the "linked sweetness long drawn out" that is supposed to characterize the angelic switchmaiden of your lightning expressions is liable to be changed to something undeniably peppery.

A device more or less complicated, intended to do away with the "central" operator, is now being brought before the public, but why the expense of such a complicated conglomeration of apparatus should be gone to in order to deprive a few young ladies of a chance to earn their daily bread is totally beyond our comprehension. Our comprehension may be limited, but while the fact remains that the annual interest on the cost of a six or eight wire system, such as the new-fangled idea requires, would be more than enough to pay the wages of expert operators, we are compelled to cry *cui bono*, what is the good? Why displace the operators whose wages are a small fraction of the expense of a telephone system in order to introduce other complications and expenses.

"The ills we have," to wit, the extremely affable young ladies at "central," we are all more or less acquainted with; now let us look at one or two that at present we "know not of," but which the eloquent automatic projectors would like to run us up against. We all know how thoroughly reliable electric currents are when there is a speck of dust in the key contacts or a leakage of battery power to ground during wet weather. This last factor is so important in the adjustment of a magnet and variation, that a telegraph operator has sometimes to keep the adjusting screw of his relay continually in his hand while using the instrument. The "automatic" exchange instrument for each telephone, containing four or five magnets, is expected to look after itself (no operators need apply), to adjust itself, to keep itself clean, to automatically put on its own bib and tucker and to go to church Sundays—in fact to lead an exemplary life generally; no one is allowed to take a fatherly interest in the orphan because—is it not "automatic"? Now we will suppose a subscriber wants to call up the general hospital and has gone through the cabalistic performance on the keys required to make the necessary number, and we will stretch a point and further suppose he has done it correctly, and some wandering microbe of a fly, as we ex-speckt he might, has been fooling around one of the contact points and the machine has slipped a cog—only one cog, mind, in the possible 9999—instead of the general hospital he would be just as likely to get the jail. Imagine what a shock to Cholly's feelings if he tried to call up his sweetheart and got an undertaker, or the effect on the presiding maiden of the Y. W. C. G. if some besotted bibulist took her for a brewery and ordered a dozen of beer and one of old Tom gin and send it in a brace of shakes at that! There would be a delightful uncertainty as to what you were going to get about the business that would be particularly charming. It would be a soul-destroying invention, no doubt of that. If you wanted the Salvation Army for instance, and got the Mercer Reformatory, you would not, metaphorically speaking, take off your hat and apologize to the polite operator at Central for not speaking plainer. Oh no! The restraining influence of that young lady's presence as it were would be absent, and you would illuminate the dark depths of the automatic's transmitter with a blue streak of indignation that would make the six wires sizzle to try and carry it all away at once.

Any system that depends on a battery current to work its mechanism at a distance, must in the nature of things be uncertain. The failure of the writing telegraph that was shown some years ago was entirely due to this cause. The apparatus would work perfectly with a definite resistance and uniform battery, but was inoperative when exposed to vicissitudes of weather and distance. If, as is proposed, a common battery main is used with branches to each subscriber, a cross on the line, liable to happen at any time, would paralyze the whole exchange.

The switch board would have the same number of connections as the ordinary telephone switchboard, with the addition of a complicated piece of mechanism in place of the plain annunciator drop of the ordinary system. Its adoption, instead of saving in the cost of labor, would simply substitute expensive mechanics for comparatively inexpensive operators.

The claim that a small country town or village could use this system instead of the ordinary one does not appear to have good foundation. If automatic instruments were installed it is idle to say that they would look after themselves. They would have to be maintained. It would simply mean the substitution of an expert to keep them in order, instead of the cheaper boy or girl whose only qualification needed would be the ability to ring a telephone bell.

The immense cost of the system in a large city would far overbalance the amount of the wages of a few girls, while the uncertainty of results would be a serious, if not a prohibitive drawback. We have fresh in our mind the words of caution given on the subject of electric investments by the president of the Canadian Electrical Association at its last convention, but do not think that investors, though they may not know very much about the matter technically, will place much faith in a telephone company who would offer to equip every town and village in the county and build trunk lines from New Brunswick to British Columbia on a capital of $250,000.

Work on the $3,000,000 contract for laying the tracks of the Montreal Street Railway was commenced on the 24th ult.

The Montreal Street Railway Company have discovered an extensive system of stealing amongst their conductors, by resorting to the old trick of putting a tube in the boxes.

A proposition has been made to count the hours for telegraphic purposes from a fixed meridian so as to obviate the anomaly of receiving news of events happening a day after it is received here.

THE COST OF STEAM POWER PRODUCED WITH ENGINES OF DIFFERENT TYPES UNDER PRACTICAL CONDITIONS, WITH SUPPLEMENT RELATING TO WATER POWER.*

By Charles E. Emery, Ph. D.

(1) The author first refers to his previous paper on "The cost of Steam Power," published in the Transactions of the American Society of Civil Engineers in 1883, stating that he had been urged to modify it to suit more recent conditions, but that he believes it still substantially correct for the particular purposes for which it was originally designed, to wit: to show the capitalized or present value of steam power in different units maintained forever. The prices of engines have varied since the paper was prepared, but this fact has proportionally little effect on the results, and in any case corrections must be made for the difference in prices of fuel.

a	b	c	d	e	f	g $g=\frac{fc}{30}$	h	i $i=\frac{g\times 22 \text{ or } 25}{500}$	j $j=\frac{1.10g}{500}+5.50$	k $k=h+i+j$	l $l=1.085k$	m	n $n=\frac{f}{m}$	o $o=\frac{11cn}{2240}$	p $p=\frac{21cn}{2240}$
DESIGNATION.	TYPE OF ENGINE. NAME.	INDICATED HORSE POWER required to produce 500 Horse Power Net on High Speed Engine Shaft, or Jack Shaft of Low Speed Engine.	STEAM PRESSURE BY GAUGE	FEED WATER PER INDICATED HORSE POWER PER HOUR. Probable Limits.	FEED WATER PER INDICATED HORSE POWER PER HOUR. Assumed for Comparison	COMMERCIAL HORSE POWER of Boilers on basis that one Commercial Horse Power requires the evaporation of 30 pounds of water at 70 lbs. pressure from temperature of 100°.	APPROXIMATE COST PER NET HORSE POWER OF ENGINES ERECTED AND CONNECTED READY FOR OPERATION.	Boilers erected and connected ready for operation on basis of $22.00 per Commercial Horse Power for steam pressure of 125 lbs. or under and $25.00 for higher pressures.	BUILDINGS AND CHIMNEY	TOTAL OF THE THREE PREVIOUS COLUMNS.	Total with 2½ per cent for inspection and 6 per cent for loss of interest during construction added	WATER EVAPORATED PER POUND OF COAL.	COAL PER INDICATED HORSE POWER PER HOUR.	TONS OF COAL (OF 2240 LBS.) PER DAY WITH AVERAGE COAL FOR ONE HOUR ADDED FOR STARTING AND STOPPING FIRES. For 10 working hours per day.	For 20 working hours per day.
		I. H. P.	Lbs per sq in.	Lbs.	Lbs.	C. H. P.	Dols.	Dols.	Dols.	Dols.	Dols.	Lbs.	Lbs.	Tons.	Tons.
A	Simple High Speed, Non-Condensing...	542	100 to 120	35 to 26	33	596	17.50	26.22	15.18	58.90	63.91	8.5	3.882	10.332	19.725
B	" Low " " " ...	556	100 to 120	32 to 24	29	537	25.00	23.63	14.22	62.85	68.19	8.5	3.412	9.316	17.785
C	Compound High" " " ..	542	100 to 120	30 to 22	26	470	21.00	20.68	13.13	54.81	59.47	8.5	3.059	8.142	15.544
D	Special Triple Compound High Speed Non-Condensing }	542	150 to 170	27 to 21	24	434	26.00	21.70	12.55	60.25	65.37	8.5	2.824	7.516	14.349
E	Simple High Speed Condensing......	542	100 to 120	25 to 19	22	397	21.00	17.47	11.95	50.42	54.71	8.5	2.588	6.858	13.150
F	" Low " "	556	100 to 120	24 to 18	20	371	27.00	16.32	11.53	54.85	59.51	8.5	2.353	6.425	12.265
G	Compound High" "	542	100 to 120	24 to 16	20	361	24.50	15.88	11.36	51.74	56.14	8.5	2.353	6.263	11.050
H	" Low " "	556	110 to 125	20 to 12½	18	334	30.00	14.70	10.92	55.62	60.35	8.5	2.118	5.783	11.040
I	Special Triple Compound High Speed Condensing }	542	150 to 170	23 to 14	17	307	29.00	15.35	10.49	54.84	59.50	8.5	2.000	5.323	10.163
J	Triple Compound Low Speed Condensing	556	150 to 170	18 to 12½	16	297	37.50	14.85	10.32	62.67	68.00	8.5	1.882	5.139	9.810
K	do do	556	160 to 170	17 to 12¼	15	278	45.00	13.90	8.35	67.25	72.97	8.5	1.765	4.819	9.200
L	Do For Probable Maximum Results....	556	160 to 170	16 to 12¼	14	259	45.00	12.95	8.15	66.10	71.72	9.5	1.474	4.025	7.683

Table 1, Showing Cost of Steam Power.

(2) The author has therefore decided in the present paper to compare the cost of developing a given amount of power with several of the different kinds of engines now in general use. A unit of 500 net horse-power has been selected, which it is assumed is delivered at a speed of 250 to 350 revolutions per minute, corresponding to the jack shaft speed of slow engines and the actual speed of high speed engines.

(3) While the writer attempts to examine all the principal causes which affect the cost of steam power, the prominent feature of the discussion is the substantial equalization of the cost of the power developed with engines of different types and different degrees of economy when expenses independent of the coal consumed are considered. Attention is called to the fact that such expenses are fairly constant and will in some cases equal the cost of coal. The result is, that if one engine saves a certain large percentage of fuel compared with another, such percentage is reduced one-half when applied to the double quantity, and in many cases the lower percentage will be balanced or more than balanced by the difference in interest on the cost of the different engines.

a	q $q=\frac{2\times 308o}{500}$	r $r=\frac{3\times 308o}{500}$	s $s=\frac{4\times 308o}{500}$	t $t=\frac{5\times 308o}{500}$	u $u=\frac{2\times 365p}{500}$	v $v=\frac{3\times 365p}{500}$	w $w=\frac{4\times 365p}{500}$	x $x=\frac{5\times 365p}{500}$	y $y=\frac{3080\times .48 \text{ or } .41}{500}$	z $z=\frac{7300\times .48 \text{ or } .41}{500}$	A $A=\frac{(.008g+3)\times 308}{500}$	B $B=\frac{(.008g+3)\times 365}{500}$	C $C=0.05h$	D $D=\frac{l}{10}$	E $E=y+A+C+D$	F $F=z+B+C+D$
	COST OF COAL PER HORSE POWER PER YEAR. ON BASIS OF 308 DAYS OF 10 HOURS EACH AND COST OF COAL PER TON OF 2240 POUNDS DELIVERED AS FOLLOWS.				ON BASIS OF 365 DAYS OF 20 HOURS EACH AND COST OF COAL PER TON OF 2240 POUNDS DELIVERED AS FOLLOWS:				COST PER NET HORSE POWER PER YEAR OF SUPPLIES AND AVERAGE REPAIRS. 308 days of 10 hours each.	365 days of 20 hours each.	COST PER NET HORSE POWER PER YEAR OF WAGES. 308 days of 10 hours each.	365 days of 20 hours each.	COST OF INSURANCE ½ PERCENT.; OF TAXES 1.0 PERCENT. OF RENEWALS 3.5 PER CENT. TOTAL 5 PER CENT. OF COSTS IN COL. h.	INTEREST OR DIVIDENDS SAY 10 PERCENT. OF COSTS IN COL. l.	TOTAL COST PER HORSE POWER PER YEAR OF ALL OPERATING, CURRENT AND INTEREST EXPENDITURES EXCEPT COAL. 308 days of 10 hours each.	365 days of 20 hours each.
	$2.00	$3.00	$4.00	$5.00	$2.00	$3.00	$4.00	$5.00								
	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.
A	12.73	19.09	25.46	31.82	28.80	43.20	57.60	72.00	2.96	7.01	4.78	11.34	2.95	6.39	17.08	27.59
B	11.48	17.22	22.96	28.69	25.97	38.95	51.93	64.92	2.53	5.99	4.49	10.65	3.14	6.82	16.98	26.60
C	10.03	15.05	20.06	25.08	22.69	34.04	45.39	56.74	2.96	7.01	4.16	9.87	2.74	5.95	15.81	25.57
D	9.26	13.89	18.52	23.15	20.95	31.42	41.90	52.37	2.96	7.01	3.99	9.45	3.01	6.54	16.50	26.01
E	8.49	12.73	16.97	21.22	19.20	28.80	38.40	48.00	2.96	7.01	3.61	9.02	2.52	5.47	14.76	24.01
F	7.92	11.87	15.83	19.79	17.91	26.86	35.81	44.77	2.53	5.99	3.68	8.71	2.74	5.95	14.90	23.39
G	7.72	11.57	15.43	19.29	17.46	26.18	34.91	43.64	2.96	7.01	3.63	8.60	2.59	5.61	14.79	23.81
H	7.13	10.69	14.25	17.81	16.12	24.18	32.24	40.30	2.53	5.99	3.49	8.28	2.78	6.04	14.84	23.09
I	6.56	9.84	13.12	16.40	14.84	22.26	29.68	37.10	2.96	7.01	3.36	7.97	2.74	5.95	15.01	23.67
J	6.33	9.50	12.66	15.83	14.32	21.48	28.65	35.81	2.53	5.99	3.31	7.85	3.13	6.80	15.77	23.77
K	5.94	8.91	11.87	14.84	13.43	20.15	26.86	33.58	2.53	5.99	3.22	7.63	3.36	7.30	16.41	24.28
L	4.96	7.44	9.92	12.40	11.22	16.83	22.43	28.04	2.53	5.99	3.74	8.87	3.31	7.17	16.75	25.34

Table 1 (Continued), Showing Cost of Steam Power.

(10) The writer submits Table 1, showing in detail the cost of one-horse power per year developed in engines of different kinds when operated for 10 hours per day for 308 days in the year, and for 20 hours per day for every day in the year, with columns showing the results in each case for coal costing $2.00, $3.00, $4.00 and $5.00 per ton. The results are at first presented on the basis that the power required is comparatively steady so that

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* An abstract of a paper read before the American Institute of Electrical Engineers, March 21, 1893, and printed in the N. Y. *Electrical Engineer*. For convenience of reference to the original paper, the paragraphs in the abstract have been numbered to correspond with the original paper.

no surplus machinery is required. A second presentation shows the results for electric light and other plants in case 50 per cent. surplus machinery be provided to supply the maximum power during certain portions of the day and the power for the remainder of the day be sufficiently low to maintain the average.

(11) The different lines of the table refer to engines of the types stated in column *b*. The author states that the last three lines are devoted to low speed condensing triple compound engines. Of these, line *J* shows the probable results with machinery designed to secure economy in construction rather than the highest economy of fuel. Line *K* refers to a low speed triple compound engine more expensively constructed, for which the economy is assumed lower than in the other case and for which the results are believed to be the best that can be secured under ordinary average practice even with the best machinery. There has, however, for comparison, been added another line, *L*, assumed to be operated at still lower economy by the use of boilers of unusual economy and careful attention to the details of operation, for which purpose $1.00 per day is added to the labor account. The results shown in this line are believed to be the maximum which can be obtained under the conditions of unusually good practice with the best care available.

The author then proceeds to describe the several columns of the table. Most of these will be understood by reading the headings. We note, however the following:

(13) In column *c*, the indicated horse-power required to produce 500 net horse-power has been fixed at 542 for the high speed engines and 556 for the low speed engines, to include the friction of transmission to the jack shaft.

(15) Columns *e* and *f* relate to the feed water per indicated horse-power per hour, column *e* showing the portable limits within which the feed water required will vary for engines of the types stated, when constructed by different manufacturers or operated under different conditions. The lower limit is believed to have been fixed in each case at the minimum result which has been obtained by reliable experiments with the class of engines referred to; these figures are therefore too low for average practice. The large figures in column *e* represent results which in the opinion of the writer may be obtained under less favorable but practical circumstances, and of course still larger costs would result from the use of apparatus imperfectly designed or improperly operated. Column *f* shows the feed water per indicated horse-power per hour assumed for comparison. The figures in this column are not intended to be averages of those given in column *e*, but those which can be safely depended upon under conditions of practice, with the load varying between considerable limits, thereby affecting somewhat the economy. It should be stated that the desire to have these figures decrease progressively where possible has somewhat influenced the values selected as well as the above considerations. Engines operating cotton mills or large numbers of small machines of any kind under conditions securing a substantially uniform load will necessarily give nearer the minimum results shown in column *e*, but engines generating electric current for electric railways or subject to variable loads of any kind will rarely show economies as low as has been assumed for comparison in column *f*.

(16) Column *g* shows the commercial horse-power of boilers on the now accepted basis of 30 pounds of feed water per horse-power. It will be noticed that the high speed non-condensing engines in line *A* required 596 boiler horse-power to produce 500 net horse-power, and that the power of the boilers continually diminishes the reduction in feed water per horse-power, so that for the case last named, line *L*, only 259 boiler or commercial horse-power is required.

(17) The cost of the boilers is shown in column *i*, the prices including not only the original cost of boilers proper, but the erection and connection of the same. This section also discusses at some length the desirability of duplicate values and connections to insure the continuous operation of boilers where stoppages cannot be permitted.

(18) The prices on above basis have been fixed at $22 per commercial horse-power for the lower steam pressures and $25 for the higher pressures. These prices are believed sufficient to provide sectional boilers with settings and all attachments, and the writer expresses the belief that this class of boilers should be estimated for, even at somewhat increased first cost, from considerations of safety and reduction in repairs. The influence on the results due to difference in the prices of boilers is discussed later in connection with Table 2, which is not here reproduced.

(20) Column *h* shows the cost of engines erected and connected ready for operation. The writer speaks of the difficulty of obtaining these prices. Circulars were sent to different engine manufacturers and all kindly responded but many did not make engines of 500 h. p. or of all the types; some gave very low prices which might not be sufficient for close specifications, others added various percentages. The cost of some steam plants complete were, however, accessible. Mr. Pearson, of the West End Railroad in Boston, gave prices checking well with the prices given for the triple compound engines, and the prices of six complete plants of various sizes, using simple engines, were obtained from advance pages of a work in course of preparation by Messrs. T. C. Martin and W. H. Schlessinger, the average of which also checked the prices stated in the table, being a little lower on account of the type of boilers employed.

(23) Column *l* shows the amount in column *k* augmented 2½ per cent. for inspection and 6 per cent. for loss of interest during construction, incidental salaries, etc. There percentages are independent of architects commissions and are intended to cover numerous incidental expenses due to starting a plant. The per-

$C_1 \equiv .0405\,k + .06\,k + .075\,i$

a	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	a
	$G = q + E$	$H = r + E$	$I = s + E$	$J = t + E$	$K = u + F$	$L = v + F$	$M = w + F$	$N = z + F$	$O = q + y + A + \frac{2}{3}D + C_1$	$P = r + y + A + \frac{2}{3}D + C_1$	$Q = s + y + A + \frac{2}{3}D + C_1$	$R = t + y + A + \frac{2}{3}D + C_1$	$S = u + z + B + \frac{2}{3}D + C_1$	$T = v + z + B + \frac{2}{3}D + C_1$	$U = w + z + B + \frac{2}{3}D + C_1$	$V = x + z + B + \frac{2}{3}D + C_1$	
	TOTAL COST PER NET HORSE POWER PER YEAR ON BASIS OF								TOTAL COST PER NET HORSE POWER PER YEAR FOR ELECTRIC R. R. AND OTHER VARIABLE WORK REQUIRING 50 PER CENT. EXTRA PLANT TO OBTAIN ON THE AVERAGE 500 H. P INSURANCE INCREASED TO 1¼ PER CENT., ENGINE RENEWALS TO 4 PER CENT. AND BOILER RENEWALS TO 5 PER CENT								
	308 DAYS OF 10 HOURS EACH AND COST OF COAL PER TON OF 2240 LBS. AS FOLLOWS:				365 DAYS OF 20 HOURS EACH AND COST OF COAL PER TON OF 2240 LBS. AS FOLLOWS:				FOR 308 DAYS OF 10 HOURS EACH AND COST OF COAL PER TON OF 2240 LBS. AS FOLLOWS:				FOR 365 DAYS OF 20 HOURS EACH AND COST OF COAL PER TON OF 2240 LBS. AS FOLLOWS:				
	$2.00	$3.00	$4.00	$5.00	$2.00	$3.00	$4.00	$5.00	$2.00	$3.00	$4.00	$5.00	$2.00	$3.00	$4.00	$5.00	
	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	
A	29.81	36.17	42.54	48.90	56.49	70.89	85.29	99.69	35.45	41.82	48.19	54.55	62.14	76.54	90.94	105.34	A
B	28.46	34.20	39.94	45.67	52.57	65.55	78.53	91.52	34.55	40.28	46.02	51.75	58.65	71.64	84.61	97.60	B
C	25.84	30.86	35.87	40.89	48.26	59.61	70.96	82.31	31.10	36.12	41.13	46.15	53.52	64.87	76.22	87.57	C
D	25.76	30.39	35.02	39.65	46.96	57.43	67.91	78.38	31.65	36.28	40.91	45.54	52.85	63.32	73.80	84.27	D
E	23.25	27.49	31.73	35.98	43.22	52.82	62.42	72.02	28.08	32.32	36.56	40.81	48.05	57.65	67.25	76.85	E
F	22.82	26.77	30.73	34.69	41.30	50.25	59.20	68.16	28.12	32.07	36.03	39.99	46.60	55.55	64.50	73.46	F
G	22.51	26.36	30.22	34.08	41.27	49.99	58.72	67.45	27.48	31.33	35.19	39.05	46.24	54.96	63.69	72.42	G
H	21.97	25.53	29.09	32.65	39.21	47.27	55.33	63.39	27.36	30.92	34.48	38.04	44.60	52.66	60.72	68.78	H
I	21.57	24.85	28.13	31.41	38.51	45.93	53.35	60.77	26.92	30.20	33.48	36.76	43.86	51.28	58.70	66.12	I
J	22.10	25.27	28.43	31.60	38.09	45.25	52.42	59.58	28.27	31.44	34.60	37.77	44.26	51.42	58.59	65.75	J
K	22.35	25.32	28.28	31.25	37.71	44.43	51.14	57.86	29.10	32.07	35.03	38.00	44.46	51.18	57.89	64.61	K
L	21.71	24.19	26.67	29.15	36.56	42.17	47.77	53.38	28.33	30.81	33.29	35.77	43.18	48.79	54.39	60.00	L

TABLE 1, (CONTINUED), SHOWING COST OF STEAM POWER.

centage will generally be insufficient rather than the contrary, except in cases where a plant is simply increased after the organization is established.

(24) An inspection of column *l* shows an unexpectedly small difference in the total cost of steam machinery of different types when everything is considered. It is a curious fact that steam machinery of fairly good economy shows the lowest first cost, the cost of the simpler machinery being higher on account of additional boilers, and that of the more economical machinery being higher on account of the higher cost of engines, etc.

(To be Continued.)

ENGINEERING AND ELECTRIC PLANT AT THE PARLIAMENT BUILDINGS, TORONTO.

THE new home of legislation for Ontario is about completed, and we give some particulars of the engineering plant which will be found interesting.

The boiler room is situated in the north basement. It contains six horizontal multi-tubular boilers built by John Abell, of Toronto. They are made of "Otis" homogeneous steel, 60,000 pounds tensile strength. Each has a diameter of $5\frac{1}{2}$ feet and is 16 feet long; the shell is $\frac{3}{8}$, the head $\frac{1}{2}$, and the dome (30 × 30) $\frac{3}{4}$ of an inch thick. The boilers have each 98 three-inch tubes running the whole length, made of charcoal iron, and are furnished with McClave's patent grate. They are provided with cast iron flush fronts of a neat design, double folding doors, and all the exposed fittings are nickel plated, which gives a good finish to the work. The boilers have been tested by hydraulic pressure to 150 pounds per square inch.

The engine is a self-contained automatic cut-off of 50 horse power, and was also made by John Abell, of Toronto. It is said to be the first of its kind built. There is also in the boiler room one of Curtis' hot water purifiers connected with the high pressure steam lines. The entire buildings are warmed with low pressure steam, and provision has been made for utilizing the exhaust steam by passing it through the purifier and heater.

The heating is carried out by direct and indirect radiators, and over 8 miles of wrought iron piping is employed in this work—5616 feet of main pipes being from 3 to 12 inches in diameter, and 37,208 feet of branch pipes varying in size according to radiators supplied. In the direct system there is 26,173 square feet of heating surface in the radiators, and the indirect supplies 5,060 square feet.

The indirect radiation to the principal rooms is controlled by a clever electric device; attached to the thermometer in the room to be heated is a small thermostat which is so sensitively arranged that whenever the atmosphere changes the reading of the thermometer from 68° F., the instrument, by its connections with the switch dampers, is able to instantly throw the cold air over, under or through the radiators in the same proportion.

Mechanical ventilation is resorted to in the buildings by means of two large extracting flues (8 × 7 each), which are connected by large galvanized iron ducts or pipes to every room in the building. The flues are each provided with an 80-inch Blackman's exhaust fan, and the main duct has a fresh air propellor 48 inches in diameter. In the main air shaft there is a cheese cloth bag screen 25 feet long for cleansing purposes, which is so arranged that when one bag becomes full a duplicate can be easily substituted.

The electric lighting is entirely on the "three wire" system and the current is supplied by the Incandescent Light Co. to the east and west ends of the building, and is conducted along the ceiling of the basement by means of a double set of "0000" mains. From these there are 18 large distributing risers, and each one supplies a section of the lighting on each flat. The total number of lights in the building, which is arranged for gas as well as electric light, is 2600, of which 2000 are 16 c. p., and the remainder 32 c. p. and upwards. About 8 miles of wire is used in order to supply these lights.

Special care has been taken to provide means by which the distributing wires, while concealed, can yet be easily got at in case of necessity. The wires are carried along the wall covered by a moulding about 5 inches deep. This is fixed round the entire room whether there are wires to hide or not, so that the work appears as part of the decoration. If the wires need attention, it is only necessary to remove a length of this moulding, and the work can be done without further trouble or any damage. It is a very simple but useful contrivance, and is said to be adopted for the first time in these buildings.

The electric light fittings throughout the several departments are worthy of notice. They are in bronze, old gold, brass and black iron. In the Legislative Chamber there are four electroliers well worth inspecting. They were made from special designs by the Central Gas and Electric Fixture Co., of Brooklyn, and cost about $1500 apiece. The metal used is polished bronze, which blends well with the other decorative work of the Chamber. Each electrolier has 24 lights, with the same number of gas burners, which are most artistically arranged. It is doubtful whether there is a finer specimen of this class of work in America, either in design or workmanship. Besides these chandeliers there are 22 brackets, each giving 5 lights, and there also is an arch of lights over the Speaker's chair.

Before leaving the electrical appliances it is necessary to mention the four electric elevators erected in the building by Messrs. Otis Bros. & Co., of New York. In these elevators the power is derived from the Eichemeyer motor, the use of which this firm controls for elevator purposes. To give motion to the elevator machinery the motor shaft is connected by a double worm gear to the winding drum, thus giving perfect steadiness of operation. The power is controlled by means of a starting wheel in the car, and is communicated to the motor in such a way that the car stops and starts with perfect ease. This is effected by means of a rack and firside arrangement, which works the brush in the face of the resistance box, thus turning on more or less current as may be required. In addition to the usual Otis safeties on the car these machines are provided with an automatic brake and with safety stops at the top and bottom of the cars' travel, which completely control their operation. The cars are overbalanced by counterweights running in wood guides, so that, as a rule, the power is simply needed to give a first impetus to the cars, after which the use of power is reduced to a minimum. Should the cable become slack, the current is immediately cut off by an automatic slack cable stop, and in the motor room and cars the state of the switch is indicated by electric indicator lights.

The whole of the engineering plant, which is one of the most extensive in Canada, appears to have been constructed and installed in a most satisfactory manner. It is under the control of Mr. A. M. Wickens, whose engineering abilities are well known. He was until recently engineer to the *Globe* Printing Co., and is a past president of the Executive of the C. A. S. E.

TRADE NOTES.

Mr. C. W. Henderson, electrical contractor, Montreal, is moving into larger premises on Bleury street.

Messrs. J. M. Harriston and H. A. Seyler, both practical electricians lately in the employ of the Royal Electric Co., are about to start business on their own account at 781 Craig street, Montreal, under the name of the Montreal Electrical Supply Co.

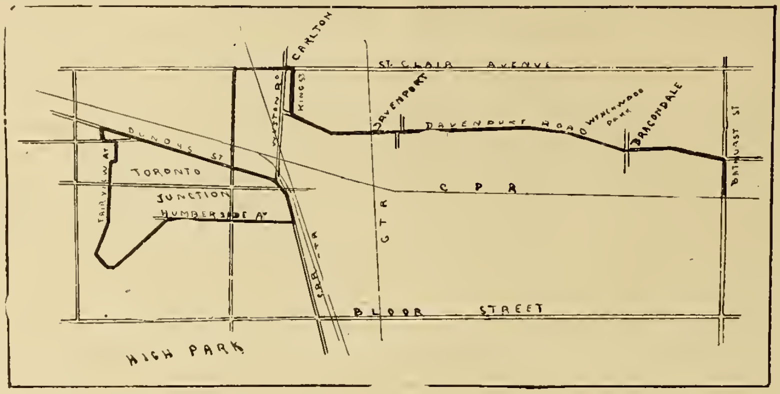
Those of our readers who were at the exhibitions held at Toronto and Montreal last year, will no doubt remember seeing an automatic high speed engine exhibited by the Robb Engineering Co. of Amherst, N. S. At that time these engines were in use only in the maritime provinces, but several are now placed and others contracted for at Montreal and other points west. This engine is one of the latest put on the market, and is up to date in every respect, the governor and valve being essentially the same as the "Straight Line," and are used by arrangement with the Straight Line Engine Co. The Robb Engineering Co. also manufacture an improved boiler called the Monarch Economic, a large number of which are in use in electric light stations and factories in the maritime provinces, and three of which, we understand, are soon to be placed in an electric light station at Windsor, Ont., along with a large Robb-Armstrong engine. Users of the boiler find it very much more economical than the ordinary brick set boiler, and it has all the advantages of light portable forms, being ready to put in position when it leaves the works.

Mr. T. W. Ness, of Montreal, has sent quite a large exhibit of the telephones and switchboard apparatus which he manufactures to the World's Fair at Chicago. Before sending it a photograph was taken, by which we notice that a very interesting display will be made. Besides the ordinary Standard Bell Telephones, which are used for private lines and local exchanges, there is a switchboard for use in central offices fitted up complete ready for work. This is a sample of the large number of switchboards which this firm has recently been building and supplying throughout Canada. Quite a large variety of warehouse telephones was also shown. This system, although largely used throughout this country, is comparatively new in the United States. Briefly described it is a system by which each telephone is its own central exchange. By turning a switch to the desired number any department of a factory may be called up from the office or from one department to another as desired. There were also a number of desk telephones on fixed and also moveable arms for special use in banks and public or private offices. Blake and Carbon transmitters, receivers and annunciators completed the list of articles sent. Owing to the patents on these articles expiring at the present time, it is expected that this exhibit will cause more than ordinary interest to those attending the World's Fair.

ELECTRIC RAILWAY DEPARTMENT.

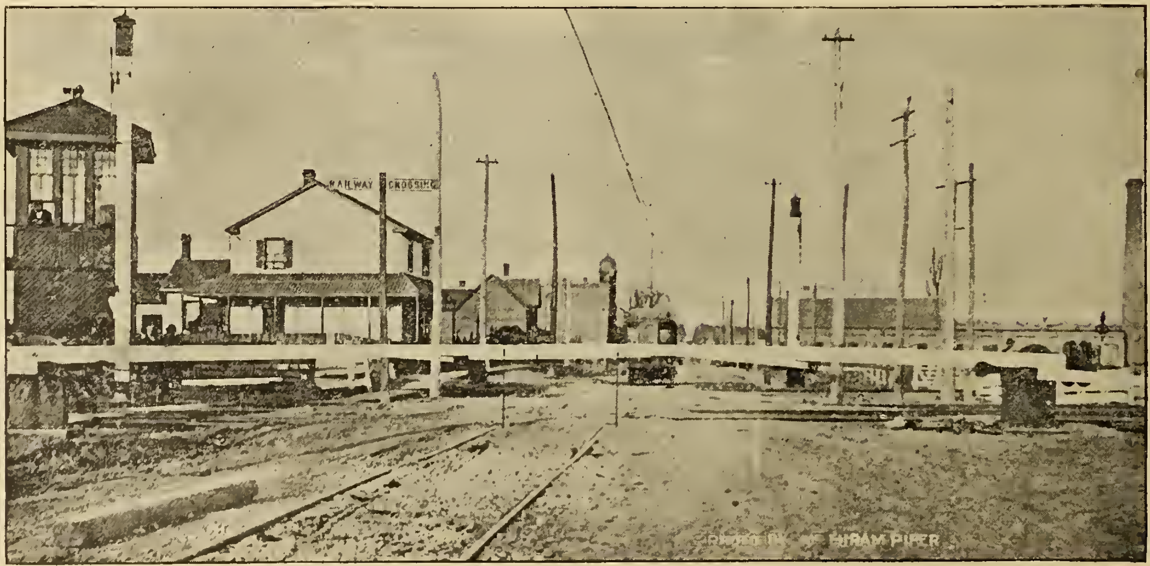
CITY AND SUBURBAN ELECTRIC RAILWAY.

In our last issue we gave some particulars relating to a proposed electric street railway to be built and operated in the eastern suburbs of Toronto. Some notes concerning the electric railway now running along the north-west limits of the city may also prove interesting.



The railway was built by the Canadian Edison Electric Co. and is the property of the City & Suburban Electric Railway Co. This company, with which is incorporated the Davenport Railway Co., has a capital of $200,000. Their offices are situated at the corner of Dundas and Keele streets, Toronto Junction.

Mr. H. W. Darling, of New York, is the President; Mr. R. H. Fraser, late superintendent of Nova Scotia Central Railway, is the manager and secretary; Mr. R. M. McNaugh, electrician, and Mr. H. Mowatt, engineer. We show a diagram of the present route of the railway which is about six miles long and has a single track with loops at convenient stages to allow cars to pass each other. The line passes under the C. P. R. tracks on Keele street by means of a substantial subway built in stone. It also crosses the G. T. R. on St. Clair avenue and again on Davenport Road. At these two points signal towers have been built with gates and proper diamonds to the tracks. This work was executed by Messrs. N. S. Piper & Son, of 314 Front street, Toronto, and is the first of its kind. We refer to this at more length in another place, giving an illustration reproduced from a photograph, of one of the junctions. Four and one-half miles of the line are laid with 56 lbs. T rails upon sleepers, and the remainder is shortly to be relaid with similar material. Along the streets in Toronto Junction the rails are 69 lbs. T rails laid on girders, and have concrete foundations where the streets are paved.



The power house, a view of which can be seen in the cut showing the crossings already referred to, is situated on the south side of St. Clair avenue, and has a car house adjoining capable of holding 12 cars. The building is in red brick, and about 150 feet long and 50 feet wide. The engine room is fitted up with 125 h.p. Leonard-Ball engine, which is coupled with a No. 33 Edison generator of 100 kilowatts or h.p. The cars, of which there are five, were built by Patterson & Corbin, of St. Catharines. They are 16 feet in length, and the interior which is capable of seating 30 persons, is fitted up exceptionally comfortable. The platform at each end is covered in by glass partitions, which not only shelter the motorman and conductor during rough weather, but greatly assist in preventing the cold from finding its way into the interior of the cars.

One car is worked by a Westinghouse motor of 50 h.p.; three have Edison motors of 20 h.p. each, and the remaining one has a similar motor of 40 h.p. Three of these are now running on the road, giving a 10 minute service.

The railway will be found a great convenience to those having to travel between the city and Toronto Junction, as the service, combined with that of the Toronto Street Railway, is far better than the railway facilities on account of the cars running more frequently. This benefit will be still better appreciated when the latter company runs an electric car service on Bathurst street.

The City and Suburban Railway Co. also provides improved means of transportation from the western to the northern suburbs of Toronto, and as the Toronto and Richmond Hill Railway, which is shortly to be built, will terminate at the same point on Bathurst street, further improvement will be obtained in this direction.

The company have made arrangements to extend their line down the west side of High Park to Swansea, meeting the Toronto and Mimico Railway on the Lake Shore Road. The track is now being laid, and it is hoped to have the cars running on this extension during this summer. As the new line passes through some of the well known Humber scenery, the cars will be much appreciated during the excursion season. It is proposed at an early date to extend the company's lines to Lambton and Weston. When these extensions are carried out, this portion of Toronto suburbs will be well provided with means of local transportation.

PROTECTION OF RAILWAY CROSSINGS.

THE introduction of electricity to street cars as a motive power, has made it necessary to introduce where the tracks cross railway lines some complete system of signalling to prevent accidents, and a perfect and ingenious set of street gates with automatic signals have been invented for this purpose. The City and Suburban Electric Railway, of Toronto Junction, have had gates of this description erected where they cross the C. P. R. tracks on St. Clair Avenue, and also where they cross the G. T. R. on Davenport Road. We give an illustration of the former gates which are operated by a signalman in the tower, by means of a crank attached to a gear stand, the one movement working the four street gate arms, four side-walk arms and semaphore signals, as follows: when the gates are open for traffic on the street the semaphore target is at right angles to mast, showing during day a "danger" signal, and at night a bright red light. The action of lowering the gates pulls the target to "safety," this being a perpendicular position, and at the same time changes the red light to white or green in accordance with rules governing colors in semaphores on the railway which crosses.

The appliance is so arranged that the gates have to be lowered to an angle of 35° before the target starts to move, and when gates reach the level, the signal is completely changed from "danger" to "safety." The same applies when gates are being raised after a train has passed, the signal gradually changing and showing complete "danger" signal when gates are at an angle of 35°. The semaphore is a positive signal in this way. The change of light is effected by an inside case holding the different colored lens, which slides on a frame, the two ruby lens coming opposite the plate glass disc in the outside case when the target is at right angles or "danger." When target is pulled perpendicular, or "safety," a corresponding movement takes place in the case, which now shows white or green light, as the case may be, where it before showed red, so that but one color at a time can be seen by the engineer on train about to cross. The gates are also equipped with red lamps, which swing between two shields which shut off the light from the trainmen and show bright red light in center of street when gate arms are down. In day-light, the red light is replaced by a bright red target, which is a great improvement on a red flag, for unlike a flag, the target does not require a wind to make it fly, and on the score of durability there is no comparison. Another advantage is that a man who has been unfortunate enough to have an arm or leg taken off on the railway is capable of attending the signal, as there is no ladder to climb, the lamp being elevated to its position from the ground by means of a chain, and the combined gates and signal easily worked with one hand from the tower. Messrs. Noah L. Piper & Son, Toronto, are the inventors and patentees of this very useful appliance. A large number of prominent railway and Government officials have inspected the gates as erected, and expressed their entire appreciation of the method adopted as a preventive of accidents. The system is well worth the attention of all companies situated so as to require the use of protective devices.

NIAGARA FALLS ELECTRIC RAILWAY.

RAPID progress is being made with the building of this line, and every effort is being used to have the railway open on the 24th of May next. When completed this will be the only road operating from its own water power, and the first time any part of the hidden power stored in the waters of Niagara Falls will have been put to any practical use.

The construction of the wheel pit and the driving of the tunnel to the river bank under the Falls, in order to provide for the discharge of the water passing through the water wheels, was no easy matter, and the engineer, Mr. R. W. Leonard, of Brantford, Ont., is to be complimented on the way the work has been carried out. The wheel pits are 80 feet deep, and contain two turbines or horizontal wheels of 1,000 h. p. each, which were made by William Kennedy & Sons, of Owen Sound, Ont. These wheels have immense iron cases, 10 feet 6 inches in diameter, set on iron girders, which are fixed to solid stone work.

The inlet canal, situated at the foot of Cedar Island, is 250 feet long, 14 deep and 18 wide. The water is conducted along this canal to a large basin and then through large iron penstocks, 7 feet 6 inches in diameter, to the water wheels. The outlet tunnel already referred to is 600 feet long, 8 by 10 feet in size and discharges near Table rock.

The electric power house is to be a handsome structure 100 x 62 feet, built in limestone, and will be situated opposite Cedar Island. Mr. Jas. Balfour, of Hamilton, is the architect, and Mr. J. G. Pocock, of the same city, the contractor. The interior of the building will consist of one large room in which will be the main shafting and three dynamos of 250 h. p. each, which are to be built by the Canadian General Electric Company.

At Queenston the railway is to be provided with another power house, near the river, in order to drive the cars up the heavy grade of the mountain, which is a mile and a half long and has a fall of 250 feet in a mile. The building will contain a boiler room 35 x 30 feet and an engine room 55 x 70 feet. The plant will consist of two engines of 150 h. p. each. The two dynamos to be used will have a capacity of 200 kilowatts.

There is no doubt the line will be greatly patronized by the excursionists who visit this locality and it is hoped that the wishes of Mr. Grant, the general manager of the company, will be realized by the line being in operation by the Queen's birthday.

MOONLIGHT SCHEDULE FOR MAY.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1......	P. M. 7.30	P. M. 9.00	1.30
2......	" 7.30	" 10.00	2.30
3......	" 7.30	" 10.50	3.20
4......	" 7 30	" 11 50	4.20
5......	" 7.30	A. M. 12.40	5.10
6......	" 7.30	" 1.20	5.50
7......	" 7.30	" 2.10	6.40
8	" 7.30	" 2.40	7.10
9......	" 7.30	" 3.10	7.40
10......	" 7.30	" 3.30	8.00
11......	" 7.30	" 3.50	8.20
12......	" 7.40	" 3.50	8.10
13......	" 7.40	" 3.50	8 10
14......	" 7.40	" 3.40	8.00
15......	" 7.40	" 3.40	8.00
16......	" 7.40	" 3.40	8.00
17......	" 8.40	" 3.40	7.00
18......	" 9.50	" 3.40	5.50
19......	" 10.50	" 3.40	4.50
20	" 11.50	....	3.50
21......	....	" 3.40	
22......	A. M. 12.10	" 3.40	3.30
23......	" 12.30	" 3.40	3.10
24......	" 12.50	" 3.40	2.50
25	" 1.10	" 3.40	2.30
26......	" 1.30	" 3.40	2.10
27......	" 1.50	" 3.40	1.50
28......	No light.	No light.	....
29......	No light.	No light.	....
30......	No light.	No light.	....
31......	P. M. 7.50	P. M. 9.50	2.00
		Total,	140.20

PERSONAL.

Mr. John Little, of Hamilton, has been appointed manager of the Windsor electric railway.

Mr. Albert E. Edkins, the president of the Executive Board of Stationary Engineers, has returned from a visit to the Lower Provinces.

After a successful career, President Higgins, the originator and manager of the National Electric Tramway and Light Company, of Victoria, B. C., has resigned.

We regret to announce the death of Mr. A. Muir, manager of the Bell Telephone Company's branch at Lindsay. The deceased was a nephew of Judge Muir and was much respected.

Mr. John W. McRae, president of the Electric Street Railway at Ottawa, is likely to be the successor to Mr. C. H. Mackintosh should that gentleman be appointed Lieutenant-Governor of the North-west Territories in May next.

We are pleased to record the recovery of Mr. W. E. Davis, the electrical engineer to the Toronto Street Railway, from his severe illness of typhoid fever. He has gone to his home at Fall River, Mass., to recuperate his health.

Mr. George W. Inglis, of the firm of George F. Blake Manufacturing Co., Liberty st., New York, builders of the new high duty pumping engine at the main pumping station of the Toronto Waterworks, has taken up his residence at 281 Sherbourne st., Toronto.

Mr. Chas. A. Bassett, of St. John, P. Q., has been appointed District Superintendent of the Bell Telephone Company of Canada over the district south and east of the St. Lawrence. We congratulate the company upon securing the services of such a well qualified man.

While Mr. Eckert, the manager of the Bell Telephone Company at Brantford, was helping to fix a wire over the Grand river, he carried an end round his waist and was dragged within a few inches of the river by some moving ice, but succeeded by a desperate effort in securing a foothold. We congratulate Mr. Eckert on his narrow escape.

CARBONS AND PORCELAIN

OF THE HIGHEST QUALITY ARE MANUFACTURED IN CANADA.

PETERBOROUGH CARBON AND PORCELAIN COMPANY.

SKETCH OF AN IMPORTANT CANADIAN INDUSTRY.

THE accompanying illustration represents the business offices and manufactory of the Peterborough Carbon and Porcelain Company, situated at Peterborough, Ont. The readers of the ELECTRICAL NEWS will no doubt be interested in learning some particulars regarding the establishment and development of this enterprise, which is the only one of its class in Canada.

Prior to 1890 all the carbons required for the Canadian market were supplied from American manufactories. The rapid growth of the electric lighting industry in the Dominion, however, led to the formation at Peterborough, in January, 1890, of the Brooks Manufacturing Co., who immediately commenced the building of the necessary plant for making carbons. The management of the company was vested in Mr. Thomas Brooks, with Mr. J. W. Taylor as Mechanical Superintendent and Secretary-Treasurer.

In April, 1890, the company commenced to manufacture, with a staff of 30 workmen, which was increased during the year to 50. Owing to the quantity of sulphur contained in Canadian coke, great difficulty was experienced in attempting to produce carbons of the required standard of quality and much loss of time and expense were sustained in replacing poor stock.

WORKS OF THE PETERBORO' CARBON AND PORCELAIN COMPANY, PETERBORO', ONT.

Just when these difficulties had in a measure been overcome, the company's factory and plant were destroyed by fire, March 17th, 1892. No time was lost in erecting new and commodious buildings, furnaces and machinery, and in less than two months from the date of the destruction of the old factory, its successor was in full operation, since which time the difficulties of manufacture have diminished to a minimum, and the quality of the product has been raised to the highest standard. The company has continued to enlarge its sphere of trade, until at the present time, *about eighty per cent. of the trade in the Dominion is supplied from these works.* This is still growing, and it can safely be predicted that it will only be a short time before the whole Canadian trade will be supplied with Canadian carbons. Last year the company were unable to fill many orders on account of their limited capacity. This had to be remedied so that the growing demand could be met. In order to do this an addition has lately been erected to the furnace room and a double furnace put in, which will almost double the output of the works. The addition is 45x27 feet and the new furnace is double the capacity of the old ones. With this additional furnace capacity, the works will now have a total output of *500,000 carbons per month*, making the year's output *six million carbons.* An addition has also been made to the plating room, increasing its capacity in accordance with the doubling of the furnace output. The number of employees has also been increased to eighty.

Having determined to manufacture also porcelain goods for electrical and other purposes, the need of a more significant name became manifest, and on December 14th, 1892, an Order in Council was passed by the Ontario Government authorizing the company to change its name from the "Brooks Manufacturing Company" to the "Peterborough Carbon and Porcelain Company."

In connection with this change of name, the *personnel* of the company was somewhat changed as follows:—

President—W. Cluxton.

Vice-President—Jas. Kendry.

Managing Director and Secretary-Treasurer—J. W. Taylor.

Directors — Thomas Brooks, George Stevenson, James Stevenson, M.P., Geo. A. Cox, T. E. Bradburn and A. L. Davis.

In the manufacture of porcelain goods the company bids fair to achieve as great success as in the production of carbons, the volume of their business in this department having doubled within the period of two months and the porcelain has the reputation of being superior to any brought into Canada. Among the great variety of porcelain goods manufactured are electric insulators of all designs, switch bases of different styles, ceiling rosettes, lamp sockets, main line and branch cut outs, door knobs, castor wheels and numerous articles of special ware required in different manufactures. The company has an order for supplying 26,000 pieces to the Bell Telephone Co., another order for special blocks for the electric lighting apparatus and fixtures in the new Parliament buildings in Toronto, and are supplying most of the carbon brushes and porcelain goods required by the General Electric Co. Since the re-organization of the company great changes and inprovements have been made in the offices at the works. As they are arranged the offices are bright, cheerful and complete in all conveniences, while they have been furnished in a style which gives them an air of taste and elegance as well as comfort.

THE

PETERBOROUGH CARBON AND PORCELAIN CO.

. . . MANUFACTURERS OF . . .

CARBON POINTS OF ALL SYSTEMS OF ARC LIGHTS,

BATTERY PLATES, CARBON BRUSHES,

and all kinds of Porcelain for Electrical and Hardware Lines.

This Company are now making a carbon equal to any made in the States, and guarantee satisfaction in every respect. The following letters, comprising the largest consumers in Canada, will fully substantiate the above statement, and we kindly solicit the whole Canadian trade, offering the assurance that we will use every effort to please our patrons :—

OTTAWA, April 24th, 1893.

THE PETERBORO' CARBON AND PORCELAIN CO., Peterboro', Ont.

Gentlemen : In reply to your request we now have the pleasure of certifying to the good quality of the carbons you have been supplying this Company. We have heretofore been buying from the Carbon Companies of Cleveland and elsewhere, but the last lot of 200,000 which we received from you, we found gave us better satisfaction, both as to life and light, than any we have ever had. We think it would be but a short time when the Canadian carbon market would be all your own. Yours truly,

THE OTTAWA ELECTRIC LIGHT CO.
(Signed) A. M. SPITTAL, Sec'y-Treas.

J. W. TAYLOR, ESQ., TORONTO, March 16th, 1893.
Sec. Peterboro' Carbon and Porcelain Co.

Dear Sir : We would like you to increase monthly shipments of carbons, as our stock is getting too low. The carbons are now giving us excellent satisfaction. We shall be glad if you can make a monthly shipment of 150,000 for three months, which will increase our stock sufficiently, and thereafter ship 100,000 per month until further orders. Do not fail to send at least 150,000 or 175,000 this month. Yours, &c.,

THE TORONTO ELECTRIC LIGHT CO. (LIM.)
J. J. WRIGHT, Manager.

J. W. TAYLOR, ESQ., MONTREAL, February 22nd, 1893.
Sec.-Treas. The Peterboro' Carbon and Porcelain Co., Peterboro, Ont.

Dear Sir : In reply to yours of the 20th instant, I beg to say that the carbons which we are using at the present time for our city and commercial lights are giving us entire satisfaction, and I have made comparative tests with the Brush (first quality), and I find there is little or no difference, and as long as you continue to manufacture the same quality of Carbon which you are at the present time, there is no reason why it should not displace or supersede all other Carbons in Canada. Yours truly,

THE ROYAL ELECTRIC CO.
J. F. BADGER, Jr., Supt. Light and Power Dept.

J. W. TAYLOR, ESQ., HAMILTON, April 20th, 1893.
Manager The Peterboro' Carbon and Porcelain Co., Peterboro', Ont.

Dear Sir : It gives us much pleasure to say that we are using carbons of your production in our lamps and find these we now have compare very favorably with the best makes from the other side. We will thank you to book our order for 25,000 7-16 c. c. to be delivered about the middle of next month. We should like to have a few samples of your one-half in. x one inch oval carbons, plain, when you get them out; we think they will turn out to be an A No. 1 carbon for all night use. Yours very truly,

HAMILTON ELECTRIC LIGHT AND POWER CO.
D. THOMSON, General Manager.

ST. JOHN, N. B., February 15th, 1893.

THE PETERBORO' CARBON AND PORCELAIN CO., Peterboro', Ont.

Gentlemen : A few days since we referred the Halifax Illuminating and Motor Co. to you for some carbons that they were in need of, and it may be that you can get some business from them. We have also to-day sent a box of your carbons to the Fredericton Electric Light Co., and if you will send them quotations upon carbons you may also do something with them. We have in both cases recommended your carbons as being a very good article.

Yours truly, THE CONSOLIDATED ELECTRIC CO., Ltd.
C. D. JONES, General Manager.

SPARKS.

A storage battery is to be used by Briggs Bros., of Hamilton, to drive their milk waggons.

The electric light company of Prescott, Ont., will install an 800 light incandescent plant.

The Gananoque Electric Light Company intend to erect a new power house and make additions to their plant.

A new telephone company is to be formed in Pembroke with rates considerably lower than those at present existing.

An electric railway is to be built under the river Thames, London, Eng. The line will be laid 77 feet below the surface.

The Niagara Falls Electric Light Company have replaced their 100 h. p. engine with one of 150 h. p., and added another 100 h. p. boiler.

A company for the manufacturing of the Wooley electro-magnetic apparatus has been granted a charter by the Ontario Government. The capital stock is $25,000.

The Hamilton Street Railway Company are increasing their power. They have added to their plant a Tandem compound condensing engine of 250 h. p., also two suitable boilers.

The Toronto and Richmond Hill Street Railway Co., are completing arrangements for laying their tracks. They have been negotiating for the supply of the required motive power, but find it will be cheaper to purchase and use their own plant. It is probable they will adopt this course.

The Ottawa Electric Street Railway Co. propose extending their service to Hull, and have offered to pay the city council for the privilege $100 per mile for the first fifteen years, $200 for the next ten years, and $300 for the following ten years, if they are granted a charter for thirty-five years.

The directors of the Hamilton, Waterdown and Guelph electric railway have decided to engage an electrical expert from Toronto to advise the company as to the dynamos to employ, and to give a general estimate of the cost of the electrical plant required. Engineer Keating is likely to be engaged for this purpose.

The Toronto Street Railway Company are taking steps to prevent accidents through passengers on their open cars getting on or off on the wrong side. Wire guards will be fastened along one side of the car covering the steps at either end and extending up to a point two feet above the seats. This arrangement will also prevent passengers while sitting down from putting their heads out, and no one can hang on the step. Engineer Keating has given his approval to the guard.

The Royal Electric Company held its annual meeting recently. The report of the year's business is very satisfactory. The gross receipts were $189,765 and the gross expenditure $118,967, leaving a balance of $70,797, or over 10% on the capital. Dividends to the amount of $52,092 were paid out of this amount, and $18,705 was carried to the profit and loss account, which now amounts to $267,639. The directors of the company are Hon. J. R. Thibaudeau, Sir Joseph Hickson, and Messrs. T. L. Beique, G. R. Robertson, E. A. Small, J. Alex. Strathy, A. R. McDonnell, H. S. Holt and David Morris.

The Bell Telephone Company have sent in two tenders for providing Montreal with an electric patrol system, the first being $21,757.50 for a complete electrically equipped system of six circuits, exclusive of conveyances and horses. This was according to the instructions of the police committee. The second tender is the company's idea of what would be a complete outfit. It comprises 100 alarm stations with six circuits, with full alarm apparatus in the central station with connections to the stables. Their price for this outfit is $24,007.07. They agree to carry the wires on their poles and keep them in repair for $2,000 per annum for 100 stations, which is at the same ratio as Toronto pays for 60 stations. Mr. Badger, city electrician, is to make a full report on the tenders.

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Dealers in Electrical Supplies.
Makers of Dynamos and Motors.
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which is the very best kind of Water Wheel for driving electric machinery by water power.
Special attention given to the arrangement and production of Superior gears, shafting, &c., for Electric Stations.
SOLE AGENTS FOR
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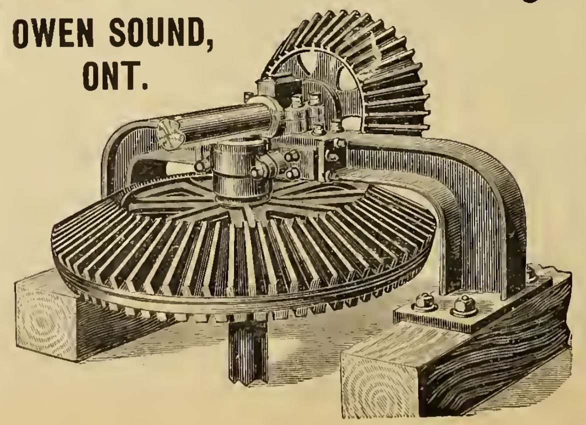

At a recent annual meeting of the Canada Mutual Telegraph Company and the Mutual Telegraph Company the following officers were elected: Mr. H. P. Dwight, president; Mr. T. F. Clark, of New York, vice-president; Mr. D. G. Perry, secretary and treasurer; Messrs. C. A. Tinker and A. S. Irving, directors.

The annual meeting of the Toronto Electric Light Company was held recently. The report shows that quarterly dividends were paid at the rate of eight per cent., and $25,000 was added to the reserve fund which now amounts to $45,000. The directors for the year are Messrs. A. H. Campbell, W. H. Howland, S. F. McKinnon, Henry M. Pellatt, S. Trees, T. Walmsley and H. Blaine, with J. J. Wright as manager.

The Canadian General Electric Company has amalgamated with the Peterboro' and Ashburnham railway for the purpose of operating an electric road in Peterboro'. The undertaking will be carried out under the charter of the latter company. The officers are as follows: Mr. T. E. Bradburn, president; Mr. F. Nicholls, vice-president; Mr. A. P. Pousette, secretary (pro tem.), with Messrs. H. P. Dwight, T. G. Hazlitt, A. Stevenson, E. H. D. Hull and W. Walsh as directors.

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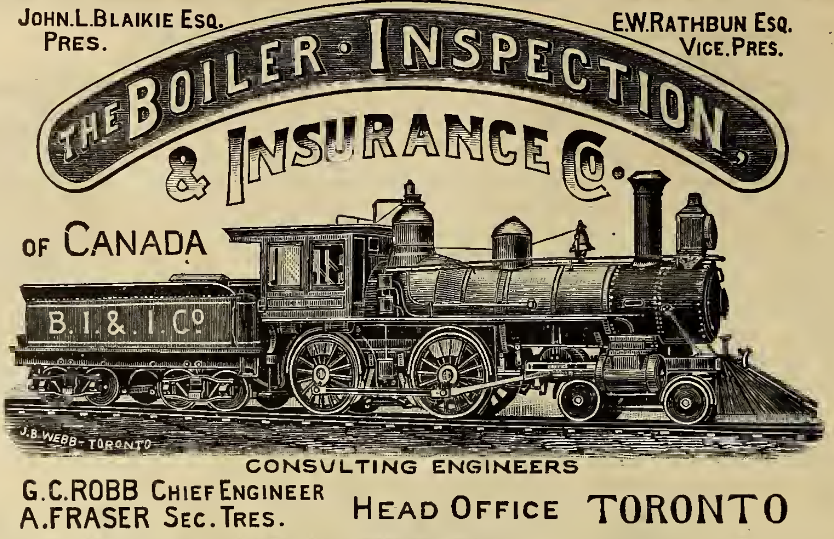

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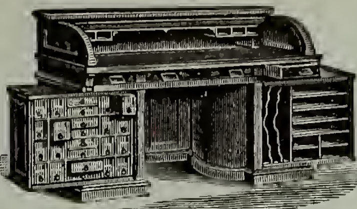

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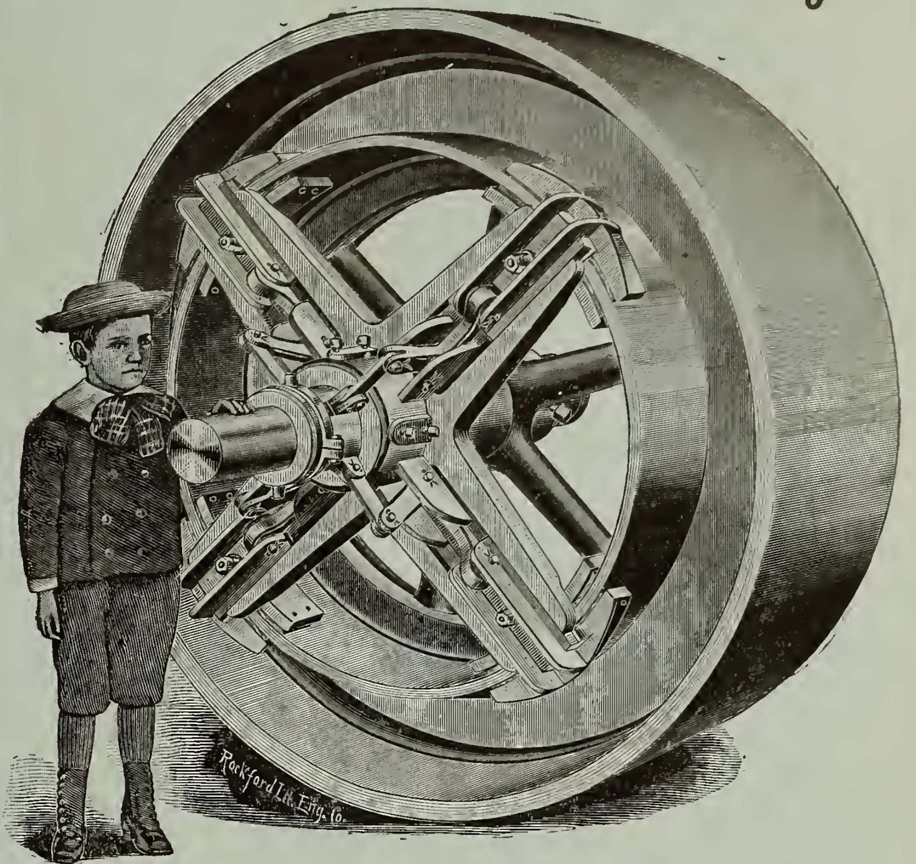
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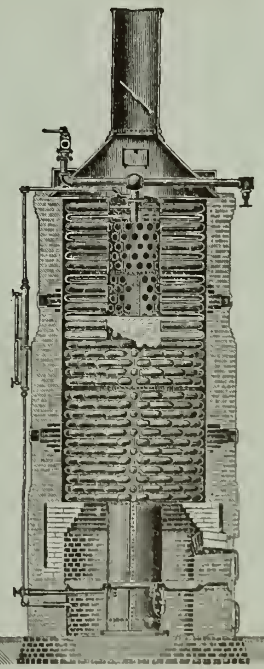

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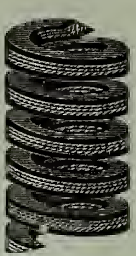

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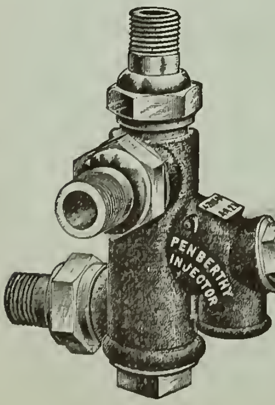

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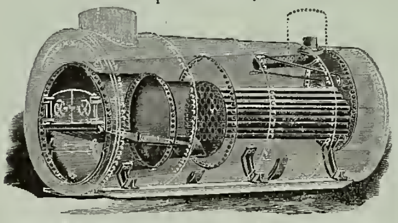

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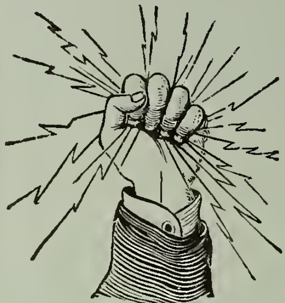

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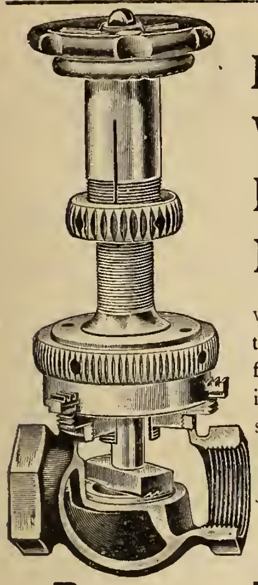

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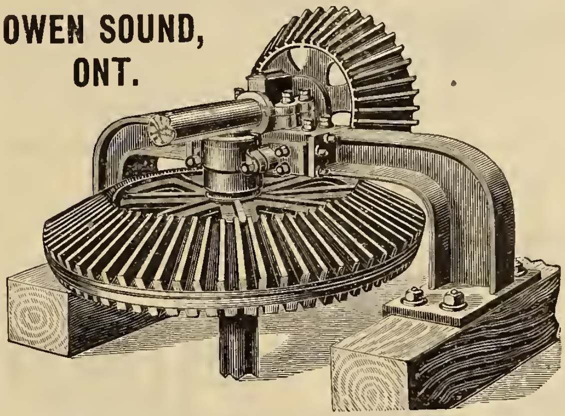

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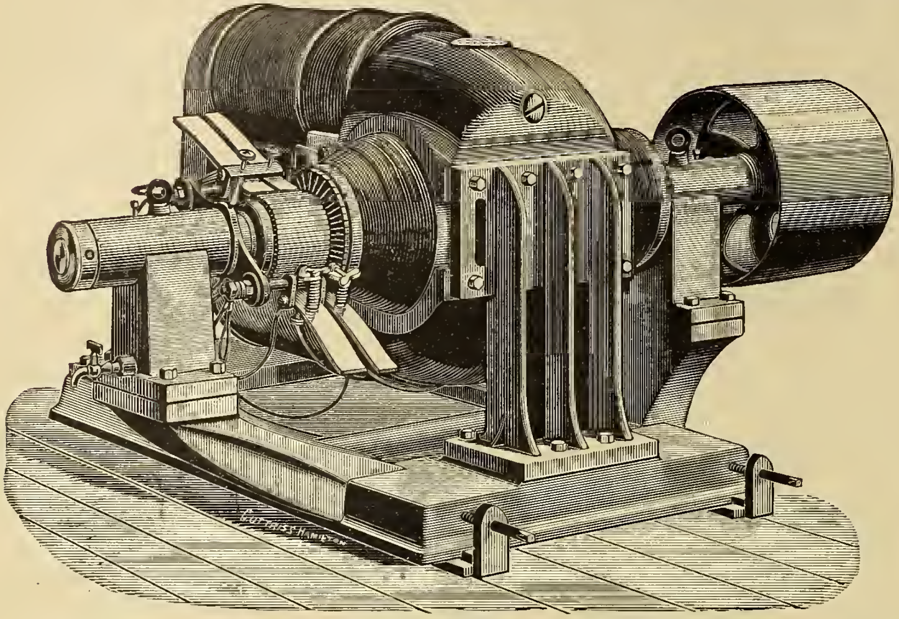

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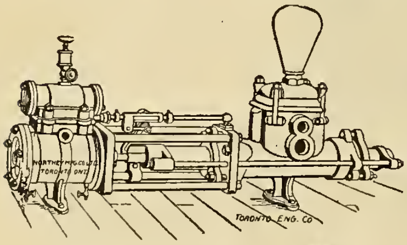

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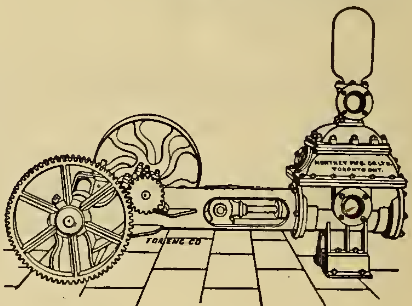
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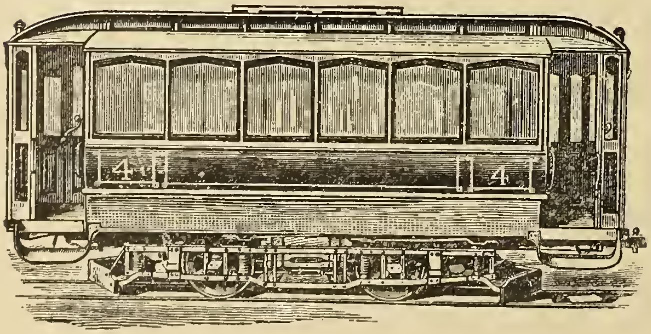

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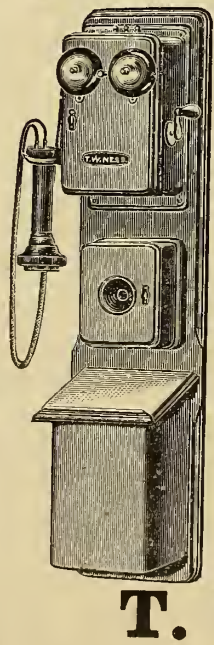

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THE BURSTING PRESSURE OF CYLINDRICAL BOILERS.

SEVERAL correspondents have recently asked for an explanation of the rule for finding the bursting pressure of boiler shells. The following article is offered as a general answer to all these inquiries.

Figure 1 shows an end view of such a shell, with the thickness purposely exaggerated. Let us assume that when the shell bursts it will separate along the line *AB*, so as to come apart in the manner indicated in Fig. 2. Now, although the steam pressure acts perpendicularly to the curved shell at every point, as indicated by the arrows, yet, so far as blowing the two halves of the boiler apart is concerned, the *effect* is the same as though the steam pressure acted vertically against a flat plate equal to the boiler in length, and equal in width to the diameter of the boiler. To make this plain let us consider Fig. 3, which shows each half of the boiler with a flat plate welded to it along its open side. Now it is a matter of common experience that a structure like one of these halves will not move upwards or downwards, when steam is admitted to its interior. That is, if it were put on a pair of scales the pressure of the steam against its inner surfaces would not make it weigh less or more than before. It follows, therefore, that the total *upward* pressure of the steam against the shell is precisely equal to the total *downward* pressure against the flat plate; the greater area of the curved shell being exactly compensated by the obliquity of the pressure against it.

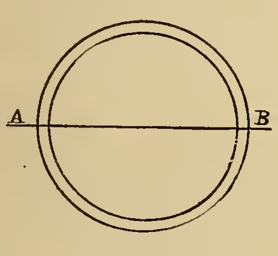

FIG. 1.

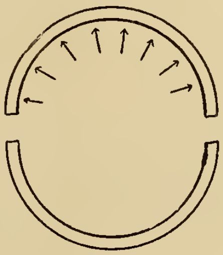

FIG. 2.

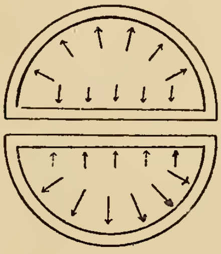

FIG. 3.

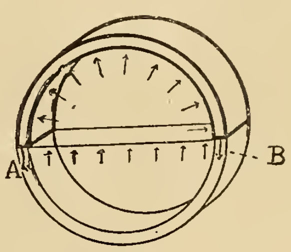

FIG. 4.

Let us now consider Fig. 4. The total *upward* pressure of the steam against the upper half of the shell is equal, as we have seen, to the pressure against a flat plate such as that shown in the cut, extending across the middle of the boiler. That is, it is equal to

$$\text{Pressure per sq. in.} \times \text{area of flat plate.}$$

But the area of the flat plate is equal to the length of the boiler multiplied by its diameter; so that the total upward pressure, tending to blow off the upper half of the boiler is equal to

$$\text{Pressure per sq.} \times \text{diameter} \times \text{length.}$$

This upward force is resisted by the strain on the boiler shell, as indicated by the arrows at *A* and *B*. The total strain on one square inch of sectional area multiplied by the number of square inches of sectional area that would be broken across if the boiler should burst. The area of the fracture along each side of the boiler would be

$$\text{Thickness of boiler} \times \text{length of boiler.}$$

and since there is one such strip on each side of the boiler, the total area broken across would be

$$2 \times \text{thickness} \times \text{length},$$

and therefore the total strain at *A* and *B*, tending to hold the boiler together, is

$$2 \times \text{strain per sq. in. of section} \times \text{thickness} \times \text{length.}$$

So long as the boiler does not burst, the force tending to blow it apart must be exactly equal to the force tending to hold it together; so that

$$\text{Pressure per sq. in.} \times \text{dtameter} = 2 \times \text{strain per sq. in.} \times \text{thickness} \times \text{length},$$

This is equivalent to saying that

$$\text{Pressure per sq. in.} \times \text{diameter} = 2 \times \text{strain per sq. in.} \times \text{thickness.}$$

And this, again, is equivalent to saying that

$$\text{Pressure per sq. in.} \times \text{radius} \times 2 = 2 \times \text{strain per sq. in.} \times \text{thickness.}$$

That is,

$$\text{Pressure per sq. in.} \times \text{radius} = \text{strain per sq. in.} \times \text{thickness.}$$

Now, when a boiler bursts it does so because the strain on the shell has become equal to the tensile strength of the material; so that in this case our last formula becomes

$$\text{Bursting pressure} \times \text{radius} = \text{tensile strength} \times \text{thickness.}$$

This is the ordinary rule for finding the bursting pressure of a cylindrical boiler, except that it is usually expressed in the following slightly different manner:

$$\text{Bursting pressure} = \frac{\text{tensile strength} \times \text{thickness.}}{\text{radius}}$$

The bursting pressure of a boiler shell, therefore, is found by multiplying the tensile strength of the material in pounds per square inch, by the thickness of the shell in inches, and dividing by the radius in inches.

In this demonstration we have assumed the shell to be a solid sheet of metal, without joints. In practice the strength of a boiler is reduced exactly in proportion to the strength of its longitudinal joints, so that we must multiply the result obtained by the foregoing rule by the decimal representing the efficiency of the joint. (The question of the efficiency of joints has been so frequently and fully considered in the *The Locomotive* that it is not necessary to discuss it in this place.) The foregoing formnla therefore becomes

$$\text{Bursting pressure} = \frac{\text{tensile strength} \times \text{thickness} \times \text{efficiency of join}}{\text{radius}}$$

which means that in actual boilers we find the bursting pressure by multiplying the tensile strength of the material by the thickness of the plate *and by the efficiency of the joint*, and then dividing by the radius.

In conclusion we shall give a few numerical examples of the use of the foregoing formula and rule.

EXAMPLE 1. What is the bursting pressure of a steel boiler (tensile strength 55,000 lbs.), 48 inches in diameter and five-sixteenths inch thick, with single riveted longitudinal joints whose efficiency is 56 per cent.? ANS. The radius of this boiler is 24 inches, so that the rule gives

Bursting pressure $= 55{,}000 \times 5/16 \times .56 \div 24 = 401$ lbs. per sq. in.

EXAMPLE 2. What is the bursting pressure of a steel boiler (tensile strength 55,000 lbs.) 60 inches in diameter and $\frac{3}{8}$ inch thick, with triple riveted longitudinal joints whose efficiency is 75 per cent.? ANS. The radius of this boiler is 33 inches, and the rule gives.

Bursting pressure $= 55{,}000 \times \frac{3}{8} \times .70 \div 30 = 481$ lbs. per. sq. in.

EXAMPLE. 3. What is the bursting pressure of a steel boiler (55,000 lbs. tensile strength), 66 inches in diameter and $\frac{3}{8}$ inch thick, with triple riveted longitudinal joints whose efficiency is 75 per cent.? ANS. The radius of this boiler is 33 inches, and the rule gives

Bursting pressure $= 55{,}000 \times \frac{3}{8} \times .75 \div 33 = 469$ lbs. per. sq. in.

EXAMPLE 4. What is the bursting pressure of a steel boiler (tensile strength 55,000 lbs.), 72 inches in diameter and $\frac{3}{8}$ inch thick, with double welt butt longitudinal joints whose efficiency is 87.5 per cent.? ANS. The radius is 36 inches, and the rule gives

Bursting pressure $= 55{,}000 \times \frac{3}{8} \times .875 \div 36 = 501$ lbs. per sq. in.

After we have found the bursting pressure, the safe working pressure may be found by dividing the bursting pressure by a suitable factor of safety. We consider 5 to be the best factor of safety when all things are considered, though we sometimes allow $4\frac{1}{2}$ when the workmanship is known to be first-class, and the materials of which the boiler is made have been carefully selected and tested. With a factor of safety of 5, the safe working pressures in the foregoing examples are as follows: Example 1, $401 \div 5 = 80$ lbs., in Example 2, $481 \div 5 = 96$ lbs; in Example 3, $469 \div 5 = 94$ lbs.; and in example 4, $501 \div 5 = 100$ lbs. —*The Locomotive.*

ELECTRICAL MEASURING INSTRUMENTS.*

BY L. M. PINOLET.

Notwithstanding its broad title, the aim of this paper is simply to describe some of the volt and ammeters most generally used in practical work and the principles of their operation. In such instruments the current to be measured, usually passes through a coil of one or many turns of wire and produces a magnetic field which is proportional to its strength. This extent of the movement gives an indication of the strength of the magnetic field and thus of the exciting current. The deflection must be opposed by a controlling force which is generally that of an opposing magnetic field, gravity or some elastic force such as that of a spring.

Ammeters have a low resistance for several reasons, the principal of which is, that, if their resistance were not low, the strength of the current to be measured would in many cases be reduced by this resistance, and an incorrect reading would be given. For a similar reason, voltemeters have a high resistance. If their resistance were low, the E.M.F. to be measured would be affected, if not considerably reduced, by the current shunted through the instrument. Voltmeters are, in fact, very sensitive ammeters, or more properly milli-ammeters; the sensitiveness being secured by having many turns of fine wire in the coil. The resistance of a voltmeter being constant, if the E.M.F. at its terminals be doubled the current flowing through the instrument will be doubled also, and will in every case be directly proportional to the E.M.F. Thus the readings, though produced by the current indicate the voltage of the circuit which is being measured. On the same principle, additional resistance put in series with a voltmeter increases the range of its readings. For example, if an instrument reading up to 100 volts, have its resistance increased ten times, it will then read up to 1,000 volts, for the current flowing through the instrument due to 1,000 volts will be the same as that formerly produced by the 100 volts.

In a large class of commercial instruments, the deflection of the pointer is produced by the action of the current upon a piece of iron. These instruments are of simple construction, but are open to the objection that the residual magnetism of the iron affects the correctness of the readings. However, by using very pure and soft iron, the residual magnetism can be eliminated to a large degree so as to render such instruments available for commercial use where extreme accuracy is not necessary.

Among this class may be mentioned the magnetic vane instruments, in which there are two vanes of thin soft iron, one of which is moveable and carries a pointer. The vanes are placed in a coil through which the current passes, and the repulsion between their similar poles which are adjacent to each other, causes the deflection. In the T-H ameters and voltmeters, a thin strip of iron carrying a pointer is pivoted eccentrically in the coil. The action depends upon the principle that, a piece of iron in a coil through which a current is passing, if not exactly in the center will be attracted to one side of the coil.

In another class, the current is measured by the attraction or repulsion between two parts of the circuit. One of the advantages of this type of instrument is, that it can be used for measuring continuous or alternating currents, for the attraction or repulsion between the two parts of the circuit is not affected if the current be reversed in both. A disadvantage is, that the action is proportional to the square of the current and, therefore, at one end of the scale the divisions are usually very close together, and at the other end they are far apart.

A recently devised instrument of this kind, is the Weston alternating and direct current voltmeter, which has been so perfected that its readings are direct and the divisions of the scale nearly equal. Other instruments of this class, are the dynamometers and Lord Kelvin's ingenious electric balances. In the latter, the attraction between a fixed and movable portion of the circuit is weighed, and the strength of the current is calculated from the weight required to balance its attraction.

The permanent magnet instruments have desirable qualities which render them very suitable for practical use. In them, the current passes through a coil in the field of the permanent magnet. One of the advantages of this arrangement is that the force with which the movable coil is deflected is directly proportionate to the strength of the current. Not only does this permit the readings to be direct, but the indications are accurate through the whole range of the instrument, from zero to the end of the scale. Nearly all the other forms of instruments have what is called a "best of range," for which their readings are most accurate, and beyond which they are only approximate. In many of them no divisions are marked on the scale for 10 or 20 degrees from the zero point.

If the magnetic construction of a permanent magnet instrument be good, and proper care has been taken in selecting and artificially ageing its magnet, it will remain accurate for many years, provided it be used with due care. The change of reading has been found to be generally less than one per cent. after three years continuous use.

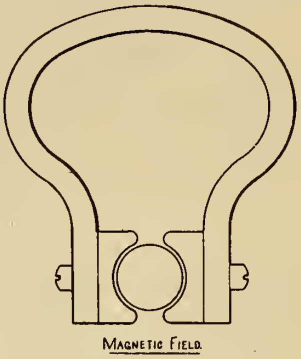

FIG. 1.

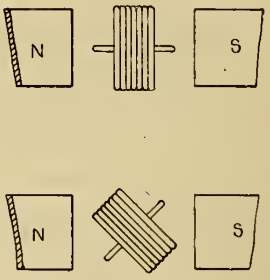

FIG. 2.

These principles of construction are illustrated in figures 1 and 2, which represent a Weston direct current volt or ammeter. This consists essentially of a permanent magnet provided with soft iron pole pieces, between which is a core of soft iron so as to reduce the magnetic lines of force and produce a strong, uniform field for the movable coil, which is pivoted on jewelled bearings and carries a pointer. The coil is set at an angle to the lines of force between the pole pieces, and when a current passes through it tends to turn so as to be parallel to these lines, and thus a deflection is produced.

Galvanometers are correctly speaking instruments in which a magnetized needle is placed in the center of a coil and the controlling force is the earth's magnetism or the field of a magnet at a distance. They are not suitable for general commercial use, for the controlling field is distorted by the proximity of masses of iron or of strong currents, and the accuracy of the instrument is destroyed. Very sensitive galvanometers are made, having a great number of turns of wire in the coils, using strongly magnetized needles, and weakening the controlling magnetic fields. Furthermore, the needles are usually provided with a mirror which reflects a beam of light on a scale, so that very small deflections may be visible and be accurately measured.

Hot wire instruments operate on an entirely different principle from those already described; the deflection being produced by the expansion of a wire by the heating effect of the current flowing through it. They are suitable for either alternating or continuous currents and are not affected appreciably by strong magnetic fields such as those of dynamos. They are specially adapted for use in plants that are subject to jars or constant motion, such as occur on board a ship or railway train. One of the best known of these instruments, is the Cardew voltmeter, in which a very fine platinum-silver wire is enclosed and supported by a tube of compound metal, whose coefficient of expansion is equal to that of the wire. The ordinary pattern reads to 120 volts, and contains 12 feet of wire, which passes several times up and down the tube and finally passes around a pulley, geared with a

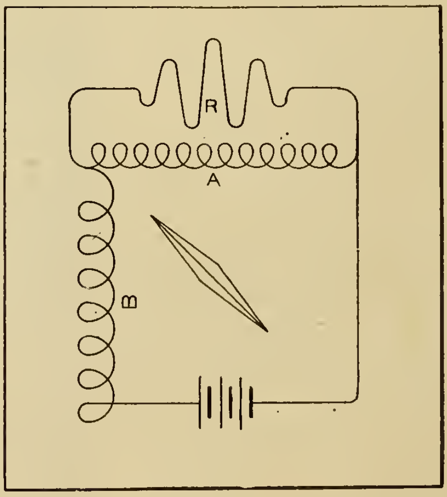

FIG. 3.

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*Abstract of a paper read before the Montreal Electric Club.

small magnifying pinion carrying a pointer. In this way, a slight change in the length of the wire, produces a magnified deflection.

Though the magneto bell can scarcely be classed as a measuring instrument, it is so extensively used that some mention should be made of it. The magneto is a small electric generator, whose armature is turned by hand, and which generates an alternating current. The current actuates a polarized bell which is arranged to ring through any resistance up to the stated capacity of the instrument, usually from 10,000 to 50,000 ohms. Notwithstanding the fact that these instruments are unreliable and are subject to give false results, they are largely used owing to their cheapness and convenience. The principal source of error is due to the alternating current, which is affected by the self-induction and static capacity of the circuit which is being tested. Cases are liable to arise were the bell will ring on a perfectly insulated line, owing to its static capacity, or the self-induction of a continuous or grounded circuit would be sufficient to prevent the bell from ringing. To overcome these objections, the use of continuous current magnetos with high resistance buzzers or detector galvanometers, has been advised.

In England, portable magneto generators are used in connection with direct reading ohm-meters. All that has to be done to measure the insulation resistance of any circuit, is to connect the instrument with the circuit and the ground. Upon turning the handle, the needle points at once to the resistance. The ohm-meters usually have a range of from five thousand to five million ohms and are graduated in thousands of ohms. The generator generates a continuous current having a voltage of 100 to 120 volts, when the handle is turned at about 120 revolutions per minute.

The operation of ohm-meters is based upon the law that the resistance of a circuit is equal to its voltage divided by the current. In these instruments, two coils at right angles to each other act upon a needle, as shown in figure 3. The coil B has a comparatively low resistance and is connected in series with the line or resistance R. The other coil A has a high resistance and is connected as a shunt across the terminals of the generator. The field of the coil A is proportional to the E.M.F. and that of B to the current through the circuit. The field of B opposes that of A, and the needle is moved more or less to one side or the other according to which field is the stronger. In this way the resistance of the circuit is indicated approximately.

MICA FOR ARMATURE INSULATION.*

The introduction of mica into practice appears to have been brought about in the following manner:—An accident would happen to an armature, and before the next night it must needs be repaired. In order to make the temporary remedy, mica sheets or bars would be interposed. In the case of subsequent accidents, the portion prepared by mica was the last to yield. Therefore it was proposed to build the armature primarily with mica. But this change took place very, very gradually, but surely. Manufacturers of stoves, the leading houses being also importers of mica, soon experienced a growth in the mica department of their business, until at present some import more for the electrical industry, especially for armature use, than for stoves. Why it was not employed from the first, no one could positively assert, otherwise than to guess that no one probably thought of it, or insulation was not considered of much comparative importance, or cheapness of material in construction was allowed to counterbalance efficiency of action and durability.

Of all substances, mica probably is the best material for use in armatures, if it is desired to obtain not only efficient electric insulation, but also durability under the influence of heat. The highest temperature to which an armature is subjected, even by short-circuit or bad construction, will have no injurious effect upon mica. Mica, thick or thin, may be held in a gas flame without cracking, burning or melting. It remains unaffected. The reason of this is better understood when it is remembered that it consists of aluminic silicate, containing also potassic, sodic and lithic silicates, and some ferrous and ferric and manganic oxides. Its chemical constitution varies.

One quality of mica is that which is commercially termed amber mica, and is usually mined in Canada. It is so named from its appearance and not because it is amber or in any other way similar to it than in its color. India mica is a commercial form noted for its uniform cleavage, extreme thinness of its laminæ, flexibility without fracture and its resistance, which is much higher than that of amber. Carolina mica is another variety. It is obtained in sheets in the western part of North Carolina. It is the best mica for stoves, but it is too hard for some electrical purposes. Mica occurs in so many specific forms that particular names have been given to it.

Muscovite is one of the most common varieties. It occurs in different colors, namely, a dark green, yellow, brown, white and gray. This is the form usually found in small scales in granite, gneiss, and mica schist, and at the same time it occurs in larger, tougher sheets than any other form. A complete scale is irregularly hexagonal in shape. Lepidolite, or lithia mica, has a pearly lustre, as distinguished from the vitreous luster of muscovite. Its scales are usually very small, and it is found in limited varieties of granite and gneiss. Cryopholite is a subvariety of lepidolite. A characteristic feature of the form meionite consists in its occurring much cracked within. It has been found in geodes. Biotite is a form found in volcanic rocks in small scales. It contains much iron and magnesia compounds. Phlogopite occurs usually in limestone. Its subvarieties are aspidolite and manganophyllite. A very little variety is lepidomelane. It is also practically opaque. Its subvariety is astrophyllite.

The insulating power of mica is superior to that of any other substance applicable to armatures. An advantage, peculiar to itself, is its even, laminated structure. How wonderful is the thinness of its individual layers! A piece of ordinary writing paper is about .005 inch. Mica layers have been obtained of a thinness of .00003 inch. Mechanical difficulties prevent its being split thinner. By pasting it upon a hard surface and splitting it off as much as possible, the remaining fragments are so thin as to become beautifully iridescent. The builder of armatures can therefore split the sheets into any desired and uniform thickness with great ease and accuracy. An interesting property of mica and one not generally recognized, is its homogeneity of structure and clear transparency, although so black when thick. The writer used a piece one-quarter of an inch thick for observing the late solar eclipse. The effect was better than with smoked glass and as efficient as black glass much thicker.

A valuable property of mica in connection with commutator insulation is its proper degree of hardness, whereby it does not wear away too rapidly under the action of the brushes. If rubber were used, for example, even if it did not burn, yet it would wear off and sparking result, because the commutator surface would not be truly cylindrical. The brushes would be set in vibration. Again, mica is capable of the finest pulverization, so that any wearing which does take place does not result in the liberation of gritty particles, which would also cause sparking. Such mishaps occur with hardened artificial plastic insulators. The insulation should be just so thick that the current cannot jump across from one section to the other.

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* From a paper on "Armature Insulation" by Chas. W. Jefferson and H. W. Dyer, read before the American Institute of Electrical Engineers.

CANADIAN ELECTRICAL ASSOCIATION.

A meeting of the Executive Committee of the above Association was held in Toronto on May 17th. Several gentlemen upon application were elected to membership in the Association. It was decided that if satisfactory arrangements can be made, the second annual meeting of the Association shall be held on the Industrial Exhibition Association grounds, Toronto, on Tuesday and Wednesday of the second week of the Exhibition. The arrangement of the details was left in the hands of the Toronto members of the executive. The Secretary was authorized to communicate to electrical manufacturers the time and place of the annual convention and suggest that they make application for space for exhibits. A resolution of thanks was passed to the President and Mr. A. B. Smith for having in the interest of electric lighting companies successfully opposed at Ottawa the passing of legislation which would have operated most injuriously to the electric lighting business.

The Secretary read letters from six or seven members of the Association who have kindly consented to prepare papers for the annual convention. In order to facilitate the proper discussion of these papers, it is intended to have copies of them printed and distributed to members prior to the date of meeting.

The outlook for the coming convention is a most promising one. It devolves upon every member to do what he can to making the September meeting one of the greatest possible interest.

QUESTIONS AND ANSWERS.

"SUBSCRIBER," Chatham: Can you give me the name of a firm in Canada who manufacture steam traps.

Ans.—As we do not know of any firm in this line, we would feel obliged if any of our readers would furnish the required information.

THE COST OF STEAM POWER PRODUCED WITH ENGINES OF DIFFERENT TYPES UNDER PRACTICAL CONDITIONS, WITH SUPPLEMENT RELATING TO WATER POWER.*

(Concluded.)

By Charles E. Emery, Ph. D.

(34) The writer finally presents in columns *G* to *N* inclusive the total cost per net horse-power per year for coal at the several prices stated, first for ordinary working hours, and second for 20 hours per day for the full year. An examination of the several columns shows clearly that for cheap fuel and short hours the engines of fair economy and least cost give the most economical results when both the cost of fuel and the collateral and interest charges are considered. Such a result would be anticipated in relation to non-condensing engines, but *it is somewhat surprising to find that the compound engines of comparatively moderate price show better economy, everything considered, than the higher priced triple-compound engines*, if we reject the results shown in the last line, which, as already stated, it is believed cannot be obtained in average practice. For the 10 hours' day with coal at $2 per ton, the lowest result is, for the assumed conditions, shown in line *I*, referring to special triple compound high speed condensing engines. Unfortunately more conditions have had to be assumed in relation to this type of engine than for any of the others. They are being made specially for electrical purposes of extra weight and with extra length of bearings, and the prices available would, with proper allowance for erection, give prices higher than stated. However, the result is very little different from that shown in lines *G* and *H* for compound engines high and low speed, or even for the simple low speed condensing engine, line *F*, on the one hand, or the triple compound, lines *J* and *K*, on the other. This similarity in final cost is certainly very interesting, and examining columns *H*, *I* and *J* referring to cost at $3, $4, and $5 per ton, we find that although the total cost per year increases, the relative cost for engines of different kinds varies but little. At the $5 rate the high speed compound engine, line *G*, has fallen $1.43 per horse-power per year behind the low speed compound engine, line *H*, and $2.67 behind the high speed triple compound, line *I*, on basis assumed, but the latter with its lower assumed original price and higher coal consumption is holding its own substantially with the higher priced compound engine, line *J*. The same relations practically hold for 20 hours per day with cheap coal, and it is not until we reach column *N* for 20 hours per day and coal at $5 per ton that the higher priced engines (rejecting as before line *L*) show any decided superiority, and even under these circumstances the difference is comparatively not great.

(35) The writer next presents in columns *O* to *V* inclusive the total cost per horse-power per year for electric railroad and other variable work requiring 50 per cent. extra plant to obtain the average power. In making these comparisons the insurance has been increased to 1½ per cent., the engine renewals to 4 per cent. and the boiler renewals to 5 per cent.

(36) Attention is called to the fact that although all the costs have been raised in the latter case, the general relations have been very little modified. For short hours and low priced coal, the medium priced engines show, if anything, still better results than on the previous basis. The engines requiring the least fuel only show to advantage for long hours and high priced coal, and even then as will be seen in column *V*, the results for the last four lines, excluding *L*, are remarkably near uniformity.

(37-38) The writer then discusses the effect of using boilers of less first cost than first assumed and presents a comparison on this basis in Table II (not here reproduced). The result is to favor the engines requiring most fuel, for the reason that they require more boiler power for a given net power. Attention is called to the fact that the same effect would result for reducing either the cost of the coal as previously stated, or the cost of handling and firing the same.

(39.) The writer states that a reduction in the cost of the numerous attachments and appurtenances necessary, or claimed to be necessary, in connection with a steam plant will decrease the interest charges generally, in a higher proportion for the more economical engines.

(40) The rules adopted for calculating the various columns of Table I are shown by algebraic formulæ ; the notation being in terms of the letters distinguishing in several columns.

(41) The writer discusses the losses in economy due to the use of non-condensing engines, with varying loads, for the reason that the back pressure forms a very large proportion of the total resistance to overcome when the loads are light and the expansion is limited when the loads are very heavy. The former consideration partly militates against the use of triple compound engines without a vacuum, unless the steam pressure is 200 pounds or upward.

(42-45) The writer then shows that considerable changes in either one of the various items will not greatly vary the final result. The following table is presented to show for four of the various engines referred to in Table I the distribution of the various items of cost. An examination of this table shows that the collateral charges, line 2, or the operating expenses except coal and interest are very nearly constant, or about equal to the cost of coal, line 1, for the economical engines, and decrease the percentage of saving due to economy of fuel simply by increasing the amount upon which the saving is to be applied. The interest, line 4, on the contrary, tends to neutralize the economy due to increased coal consumption and therefore makes the cost of power under ordinary circumstances, when everything is considered, substantially the same for a number of different kinds of engines showing considerable differences in coal consumption.

	Simple High Speed Non-Condensing.	Compound High Speed Condensing.	Special Triple Compound High Speed Condensing.	Triple Compound Slow Speed Condensing.
Lines of Table 1.	A	G	I	K
(1) The costs of coal at $3.00 per ton. Col. *r*, for a ten hours day are for the engines stated in the headings at the right.	$19.09	$17.57	$ 9.84	$ 8.91
(2) The collateral operating expenses, excluding interest, are (Line E–line D)	$10.69	$ 9.18	$ 9.06	$ 9.11
(3) The interest charges, Col. D, are	$ 6.39	$ 5.61	$ 5.95	$ 7.30
(4) The total costs, Col. H, are	$36.17	$26.36	$24.85	$25.32

(47) The writer states that the paper should not be considered a criticism of the practice or views of others or serve to discourage the higher development of the steam engine. The investigation simply shows under what conditions the higher-priced machinery is more economical and under what conditions the saving in fuel is balanced by other considerations. In some cases other conditions must be included for a complete solution of the problem. For instance, in large steamers making long voyages economical machinery secures in addition to the saving in the cost of fuel a saving in the space required to carry the machinery and fuel and thus increases almost in geometrical ratio the efficiency of the ships. This may not be true for vessels making very short trips or stopping a large proportion of the time in port. Reference is made to the high expenditures warranted in some mining regions where coal is very high-priced and illustrated by the remarkable work of Mr. E. D. Leavitt in this direction. The paper, however, states that the development of the great West is now so modifying the conditions that a change of policy will be initiated even at the Calumet & Hecla mines in the near future. The writer during a recent business investigation with an electrical outlook ascertained that the prices of coal in Duluth and Superior, beyond the Calumet & Hecla peninsula, are even now reduced even to those ruling on seabord, due to the coustruction and operation of large whaleback steamers which take wheat eastward and coal on their return trips.

(48) The writer states that the considerations expressed in the paper may prevent the use of specially designed pumping engines in the future where coal is reasonably cheap and concludes that the further perfection of the steam engine will not be hindered by the general facts stated, since with the deve-

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* An abstract of a paper read before the American Institute of Electrical Engineers, March 21, 1893, and printed in the N. Y. *Electrical Engineer*. For convenience of reference to the original paper, the paragraphs in the abstract have been numbered to correspond with the original paper.

lopment of mining industries at great distances from coal fields the closest economy in the use of fuel will secure the best commercial results. In order, however, to secure such results for growing enterprises, electrical and otherwise, in the cities and towns along lines of communication already established, the writer believes that the field will be occupied by cheaper engines of simple construction, which, though not securing the maxium economy in fuel, will so reduce the capital upon which interest and dividends are to be paid as on the whole to represent not only better commercial policy but better engineering, because based on more complete conditions.

SUPPLEMENT RELATING TO WATER POWER.

(49) The writer states that it will be impossible in connection with his paper to make a satisfactory comparison of the relative advantages of steam and water power under different conditions, but as the cost of steam power has in the paper been considered on a somewhat different basis than customary previously, he considers it important to examine the cost of water power briefly in the same way, more particularly to show what amount can be paid for the development of a water power in competition with steam power. He does not think that examples should be selected where Nature has specially favored the development of water powers at a nominal cost or where the operations of the general government have assisted the mill owners at the Falls of St. Anthony, but that the question should be discussed under more general conditions such as have been developed on the Merrimac.

(50-52) From the paper of Prof. Swain in the census reports and testimony in various water suits, he concludes that the development of water-power on the Merrimac has cost about $142 per horse-power, to which the Merrimac owners, are, however, obliged to add the greater part of the cost of a steam plant for use when there is no surplus water, and continues that it has long been known that the water power on the Merrimac has cost so much for development that could the expenditures be recalled it would be more economical to locate where coal can be obtained at cheaper rates and steam power used exclusively. Notwithstanding these considerations, however, a new water power is being developed at Sewall's Falls near Concord, which, it is supposed, however, will not be subject to the initial costs of the other large plants.

(53) The writer considers the highest allowable cost for the complete development of a water power, from the dam to the jack shaft, to be about $140 per horse power utilized on a 10-hour basis. The sum of the various items of cost such as depreciation, taxes, interest and operating expenses, he considers to be about 17 per cent. of the original expenditure. If the expenditure be $140 per horse-power, such percentage represents $24 per horse-power per year or about the same as shown in the tables for economical engines and coal between $2 and $3 per ton. If there were one company to furnish the power and another to utilize it, the balance in favor of steam power would be somewhat greater. When, however, the power is used for 24 hours per day a much greater original cost is permissible.

(54) When the power of waterfall is to be delivered at a distance, the allowable cost of actually developing the power must be decreased by that necessary to transmit the power and actually deliver it to a jack shaft at a given distance. An electric transmission is undoubtedly the most economical for such a purpose. If we add to the cost of the dynamos, that of buildings, of the hydraulic connections to the canals, of the turbines, of the line and of the installation, and finally add the cost of the motors, so that the power is according to the assumption delivered to a jack shaft, and total cost of what may be called the "electrical transmission plant" cannot probably at present prices be put in for $140 for each net horse-power delivered, so on a 10-hour basis no expenditure could be allowed for the general development of the water power, but only for the simplest hydraulic connections to existing canals, etc. If, however, power can be sold throughout the whole twenty-four hours, more than double the price can be obtained for the same and this will warrant doubling the total cost of development unless a greater percentage of income is desired. At the cost of the electrical plant remains the same, the whole allowance increase may be applied to the development of the hydraulic plant, thereby entirely changing the conditions.

(55) The writer has not hesitated to recommend an original expenditure of $200 per horse-power for a combined hydraulic and electric plant near large cities, where not only the customary income due to incandescent and arc lighting and the use of small motors at high rates would be available for comparatively short hours, but where the industries are such that large units of power could be sold at remunerative prices on a 24-hour basis. Even higher costs for development would appear to be warranted in some locations, but there is no general rule on the subject. The allowance expenditure in a particular case can only be determined from calculations based on the actual conditions.

STUDY OF ELECTRICITY BY ENGINEERS.

THE following are extracts from an address delivered before the Nashville (Tenn.) Association, No. 1, N. A. S. E., Jan. 13 1893, by F. G. Heeger:

I will once more call your attention to the necessity of studying, and as regards electricity. In the year 1889 Mr. Hobart, said that about the year 1895 engineering papers will contain advertisements like the following:

> WANTED:—By a small manufacturing firm, a capable engineer, must be able to use indicator, keep his plant up and get the best possible results from fuel burned. A knowledge of electricity indespensable. Must know how to run dynamo electric machines, and keep them in good shape. Good pay to right man.

How far did Mr. Hobart miss it? This is sufficient to demonstrate the great necessity of providing yourself with an indicator and learning how to use it with precision. How many of us would pass muster, if put to a rigid test, to-day? Can we look at a working dynamo and tell in a minute whether or not the machine is doing its full duty? I fear many a good steam engineer would get sadly left were he to be judge according to the standard of 1895. "Why should I know anything about electricity?" asks the gentleman on my right. "Why, I have run engines for thirty years and I see no reason why I should become an electrician now. It is my business to run the engine and not the machinery it drives. If that manufacturer wants to make electricity out of steam let him hire an electrician to do it, and I will stay by my engine, as I have always done."

Such argument sounds all right; but it won't work, all the same. Electricity is a very peculiar thing to deal with, and it cannot be handled by any other than electrical methods. There is no one so capable of undertaking it as an intelligent engineer. Give him an extra dollar per day and it ought to be sufficient inducement for any man to apply extra knowledge to a few minutes work through the day.

Engineers—is there a man among us worthy of being called by that name, who does not hope some time to get above his present level and be "chief engineer" of some large establishment? Certainly every one of us have such ambition and should put in all his leisure time in fitting himself for such a position.

Imagine the chief engineer of a large building, which uses hundreds of electric lamps, who had no knowledge of electricity. "Well," you say, "what of that?" You can see at once that he would be at the mercy of every young dude of an electrician who chanced to visit the plant, and even if such a man acquired such a position he would not be qualified to discharge his duty.

THE TELEPHONE GIRL.

DOES it ever occur to any one of many men, that he is daily taking part in a strange proceeding that was never indulged in up to a few years ago? Nearly every day he is conversing with a person whom he does not see, perhaps never did nor never will see. And yet the conversation is as purely a matter of course as his conservation with his wife at the breakfast table.

The particular reference is to the Telephone Girl, that Sweet-Voiced Mystery at the Other End of the Wire, that Desirable Unknown, and Tantalizing Incarnation of Thouartsonearness and Yetsofarness.

There are others unknown with whom one converses in the course of a busy day, but they are nothing compared with the Electric Goddess of whose material charms we wot not, but whose voice is like the thrumming of an elfin harp on a star-plumed night in June, or the tinkling of the lily bells that call the fairies to their revels, or the murmur of a crystal brook gliding over pebbly bottoms in a sun-filled meadow.

But we know not her Identity; we wonder who she is, when the 'phone vibrates click-clickety with whirring and with whiz. Implore of her to call her name, she merries at our bellow; with laugh like pour of molten pearls she answers only "Hello!"—Toronto *News*.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of the various Associations are requested to forward us matter for publication in this Department not later than the 20th of each month.

The annual meeting of this Association was held on the 24th of May at Shaftesbury Hall, Toronto, the president, Mr. A. M. Wickens, presiding. There were about forty delegates present, from London, Brantford, Galt, Hamilton, Peterboro', Kingston and Toronto. The meeting was called together in the morning about 11 o'clock, when the president opened the proceedings with a short address. He referred to the satisfactory progress the Association had made since its legal organization two years ago, pointing out the difficulties which had to be contended against during the first year on account of the scarcity of funds. He, however, anticipated that its prosperity would greatly increase during the coming year as funds were largely on the increase owing to the entrance of many new members. He estimated that by the end of the year over 300 new certificates would be issued, because the examiners had now better opportunities to visit the different manufacturing centres in the province. This work, he thought, should be encouraged and helped as far as possible. Although much had been done in the past, yet he hoped that the large expectations of the coming year would be realized.

The Registrar (Mr. John A. Wills), presented his report for the year, which was considered very satisfactory. It showed that there were 180 certificates in force in the province, and that the financial condition of affairs was good. After the report had been received and adopted, the election of four officers took place to fill the four vacant places left by members retiring at effluxion of their time of office according to the by-laws. The result of the election was as follows: Mr. James Delvin, (re-elected); Mr. Fred. Mitchell, of London; Peter Stott, of Hamilton and Fred. Donaldson, of Toronto.

The officers for the coming year were next appointed as follows: President, John A. Wills, Toronto; Vice-president, Robert Dickinson, Hamilton; Treasurer, Robert Mackie, Hamilton; Registrar, A. M. Wickens, Toronto.

A discussion took place with regard to improving the examinations, and a committee was appointed to consider the advisability of improving the questions and making them more searching, especially as regards the first-class certificates. Up to this date the Board of Examiners have received no pecuniary remuneration for their services, but as their work is greatly on the increase a by-law was passed after some discussion, allowing them a small sum.

The meeting adjourned at 3 p. m. until the 24th of May, next year, when it will meet at London, Ont. At the close of these proceedings the visiting delegates were conducted over the Toronto Electric Light Company's station, with which they were highly pleased. Many of them afterwards left for their homes, but a few remained over until the following day and visited other places of interest.

TORONTO NO 1, C. A. S. E.

At the meeting of the above held on the 26th inst., about 50 were present. Among the business transacted one new application was received and the following resolution passed:

Whereas—It has pleased our allwise Creator and Heavenly Father to remove from this earth the little daughter of our worthy friend and esteemed Brother T. Graham, therefore be it resolved, that while we bow in humble submission to the Divine will of our Heavenly Father, we at the same time extend our sincere and heart-felt sympathy to Brother Graham, his wife and family in this their hour of sorrow, and be it further resolved, that a copy of this resolution be sent to Brother Graham, be spread on the records of this association; and also that a copy be sent to the ELECTRICAL NEWS for publication.

At the close of the business meeting the association celebrated its seventh anniversary with a social and musical entertainment. Mr. A. M. Wickens was asked to preside. In the course of his opening remarks he said he believed these social evenings were the means of bringing the members closer together, and of making the new-comers feel more at home. He would like to see more of them. The Association was a means of mutual improvement to all, but members should also encourage sociability. There was no doubt that a large future was before them, for their certificates were becoming of great value, and already they were of many times more value to the holder than the cost of obtaining them

Mr. Edkins corroborated the last speaker in reference to the desirability of encouraging sociability among themselves. There were many benefits to be derived from an association like this, and during his visit to other places he found a better feeling was being shown to stationary engineers. He also referred to the coming convention at Montreal, and invited the members to prepare some papers on interesting subjects to read there. At any rate he hoped all would make an effort to be present, as a great time was expected.

Mr. Lewis said he had much to thank the C. A. S. E. for. With hard study and its help he had been able to secure a first-class certificate which he had found of great value to him. He hoped all stationary engineers would endeavor to go in for the examinations, and as far as he was able he would be pleased to help any brother in this matter.

Mr. Gilchrist hoped that the social evenings referred to and desired would not be the means of letting them forget their main object, education. A noble work was being done by the Association. It had elevated their work to a point which nothing else could have done.

After a few remarks from the vice-president and all present had partaken of some light refreshments, Mr. J. Martland was called upon for a piano solo, which was followed by Mr. Blackgrove singing "Wonders of the Deep." A duet followed by Messrs. Blackgrove and G. Grant, which received a well earned encore. An instrumental trio by Messrs. Walmsley (guitar), Mills and McHenry (banjo), was well rendered, as was Mr. G. Grant's song, "Under the Poplar Trees." Mr. McHenry gave a banjo solo, which was followed by a solo from Mr. Walmsley, entitled "Many Changes I Have Seen," its reception compelling him to give an encore. Mr. Henry's song "On the Bowery," and Mr. Grant's "Brawley, How's Yersel," were well received. After another banjo solo from Mr. McHenry, Mr. Walmsley concluded the enjoyable entertainment by singing "Always Do to Others as You Wish to be Done By."

After a vote of thanks, proposed by Mr. G. C. Mooring, and seconded by Mr. J. Wadge, was passed to the several musicians for their talented services, the meeting was brought to a close by singing God save the Queen.

TELEPHONIC COMMUNICATION WITHOUT A SPECIAL LINE.*

By G. MARESCHAL.

I have noticed that if I attach one wire to a gas pipe and another to a water pipe and connect the two to a telephone, the existence of a current will be proved by the sound in the instrument upon opening and closing the circuit. To measure it I have substituted a galvanometer for the telephone and as nearly as I have been able to determine with the primitive apparatus at my disposal, the deviation corresponds to a quarter of a volt. What is especially remarkable about the current is its continuity. The needle of the galvanometer has remained almost stationary for a year, varying one or two degrees to the right or the left during the course of each day.

It was my first impression that I had proved the existence of an earth current, but in view of its continuity I came to the conclusion that the action was rather that of a battery of which the water and gas pipes formed the elements, which were attacked by the media in which they were located. The positive pole is the water pipe and the negative the gas pipe. I have repeated the experiment with success in many houses in Paris and elsewhere; but no current was found in places where the pipes were in close contact.

At my own home the current disappeared for about two months in consequence of the introduction of gas pipes in a certain room. It is likely that the workmen unwittingly established a contact between the two pipes. The experiment is an interesting one to make; all those who have a common galvanometer, or better yet, a telephone, can investigate the existence of the current.

But can the current be utilized? The current strength is so small that perhaps it is not likely. However, it would be easy to design some little motor that would revolve indefinitely and this movement might be utilized perhaps by a skillful mechanic for operating a tiny clock.

It is a sequence of this experiment that the pipes are relatively insulated most of the time, and I wondered if they could not be used as the two wires for telephonic communication. As a matter of fact I have been able to talk with a friend living six doors away, using the pipes as conductors. The experiment was conducted in a very simple fashion. In my own room were placed three bichromate cells and in the circuit was connected a microphone without the induction coil; in the neighboring house was arranged the telephone connected to the two pipes. An article from a daily paper read in my room was heard perfectly in the house of my friend. We then elaborated the experiment. The microphone was placed behind the piano and music was heard in several houses on the same street and on a neighboring street.

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* Abstract of an article in *La Nature.*

THE EFFICIENCY OF THE STEAM ENGINE JACKET.

The Institution of Mechanical Engineers of England sometime since created "The Research Committee on the Value of the Steam Jacket." The second report of this committee was recently presented. In addition to collecting what information they could from outside sources, they presented in detail the records of five original sets of experiments, most of which were made specially for this report. In each case the investigation covered the performance of the same engine, both with and without steam in the jackets. The first set of experiments was made on a compound jet-condensing beam pumping engine, the second on a triple-expansion pumping engine, the third on a compound mill engine, the fourth on the experimental engine at the City and Guilds of London Central Institution, and the fifth on an experimental vertical engine.

From the records thus obtained it appears that the expenditure of a quantity of steam in an immense jacket produces a saving of a greater quantity in the cylinder. The ratio between these two quantities is an important factor in this investigation. Unfortunately, the jacket water has not been recorded in many of the experiments of which the results have been collected ; but in all trials made by members of the committee it has been carefully measured. In the summary column q gives the percentage saving in feed water resulting from the use of the jackets ; column p gives the actual saving in pounds per indicated horse power per hour ; and column r gives the water condensed in the jackets in pounds per indicated horse power per hour. The following examples are taken from the tables :

	Saving in feed water with jacket.	Actual	Water condensed in jacket.	Ratio.
a	q	p	r	p to r
No.	Per cent.	Pound	Pounds per h. p. per hour	
41..	17.4	5.15	3.29	1.9 to 1
42..	8.6	2.76	1.20	2.3 to 1
43..	10.3	3.50	1.72	2.0 to 1
44..	19.0	5.82	1.13	5.2 to 1

No. 44 shows that for every 1.13 pounds of steam expended in the jackets there is 5.82 pounds less feed water passed through the cylinder, the net saving being thus 4.69 pounds.

The experiments showed that, generally, the smaller the cylinder the greater is the percentage of gain from the use of the jacket, arising doubtless, from the fact that a small cylinder gives a larger jacket surface for a given weight of steam passing through it than a larger cylinder does.

In some of the experiments it was possible to measure both the consumption of coal and that of feed water and as these figures have considerable practical value and interest, they are in every case added to the results. Some, therefore, form complete engine and boiler trials, but it must be remembered that the effect of the jacket is measured only by the consumption of feed water and not of coal.

The single-cylinder condensing engine experimented with had a cylinder 15 inches in diameter by 30 inches stroke. The body and both ends of the cylinder were jacketed. The pressure in the jackets ranged from 48 to 187 pounds per square inch above the atmosphere, the result being that the pounds of feed water per indicated horse power with the low pressure were 28.85 and with high pressure 19.85. Other experiments made with engines of the same type showed an economy due to the use of the jacket varying from 7 to 12½ per cent.

In experiments with a compound non-condensing engine the pounds of feed water per indicated horse power per hour were 26.29 without the jacket and 25.25 with the jacket. Two other jacket experiments are also recorded which show an economy of 15 per cent. In the test of a triple expansion condensing vertical inverted engine, having cylinders 5, 8 and 12 inches in diameter, and 10, 10 and 15 inch stroke, the engine being on three uncoupled cranks, the results showed that without the jacket 16.42 pounds of feed water were recorded for each indicated horse power per hour, while only 13.56 pounds were recorded with the jacket. In this engine 64.7 per cent. of the internal surface of a high pressure cylinder was jacketed, 67.1 per cent. of the internal surface of the intermediate cylinder, and 75.2 per cent. in the low pressure cylinder.

The discussion following the presentation of this paper brought out as the most prominent feature the fact that the opinions of English engineers vary about as much regarding the actual efficiency of the steam jacket as do those of American experts, and further, that the Institution of Mechanical Engineers resembles our own Society of Mechanical Engineers, in one respect, viz., that of being fearful of advancing a positive opinion on any disputed topic either through one of its authorized committees or as a body. Professor Unwin said he was sorry the committee had decided not to express any opinion, as that curtailed the possibility of criticism. He thought it an extraordinary fact that the experiments had not produced a case in which the jacket had done any harm.

English engineers, as was brought out during the discussion, are practically unanimous in the belief that the steam jacket is economical, but they are not united as to how far the jacketing should be carried. One speaker noted that there was no case mentioned in the report of the pistons being jacketed, and said he had known instances in which the required power had not been developed until the pistons had been arranged to take steam inside. He also advocated the jacketing of the piston rods, as they must carry off a good deal of heat by passing from the interior of the cylinder to the air. He would also jacket the steam pipe. He illustrated the value of the jacket by stating that the power of an engine had been increased from 41¾ horse power to 49½ horse power in five minutes by putting the steam jacket into use.

It is not necessary to further review this report or the discussion it elicited. Our knowledge of the real work done by the jacket and of the efficiency its use produces is being increased little by little ; yet there remains much to be done and many experiments to be made before we shall possess facts establishing the true value of the jacket under all conditions. In this connection the paper by Professor Carpenter on steam jackets, read at the last meeting of the American Society of Mechanical Engineers, and the discussion by Prof. Thurston will be read with interest.—*Iron Age.*

PRACTICAL RULES.

SEVERAL correspondents of the *London Electrician* contribute a number of approximate practical rules, among which are the following :

To reduce centimetres to inches multiply by 4 and deduct one inch in every five feet. To reduce metres to yards, add one-tenth, deduct one-tenth of this correction and add one-third of the last correction. To reduce kilometres to miles, multiply by 6 and add one mile in every thirty.

To ascertain velocities in miles per hour, take any convenient distance in yards, measure the time, divide yards by the seconds and multiply by two ; this will give the miles per hour approximately.

A horizontal belt, one inch wide, running at ten feet per second, will transmit one horse power if the pulleys are not too small ; an increase of width or speed will transmit a proportional increase of power.

A pipe one inch in diameter holds one pound (or 1 gallon) of water in one yard running the capacity of a yard of any pipe in pounds may therefore be represented by its diameter in inches squared ; for greater accuracy, add one-fiftieth. To find the capacity of a cistern, remember that eight cubic feet contain 500 pounds, or 50 gallons of water.

The resistance of any copper wire is the length in feet divided by the cross-section in square inches and multiplied by .000008. For greater accuracy add 10 per cent.

For finding approximately the current in a wire, place it parallel to the magnetic meridian, place a small watch charm compass under or over it and move it until the deflection is 45 degrees, then the difference from the needle to the wire in centimetres multiplied by .9 is the current in amperes. If the deflection is 48 degrees it is not necessary to multiply by .9 If the distance is measured in inches, multiply by .35. It will be close enough to divide the distance in inches by 3.

The Yarmouth electric street railway have declared a dividend of 6 per cent. on the eight months their system has been operated.

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Correspondence is invited upon all topics coming legitimately within the scope of this journal.

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FOR several months past the incandescent electric lamp has held a prominent place in public attention. Soon, however, its glory will in a measure be eclipsed by that of the half-forgotten, fly and heat dispelling, comfort-giving electric fan.

THE Canadian Pacific Railway has locomotives running between Toronto and Montreal which have steam cylinders 19 inches diameter, 24 inches stroke, and using steam of 180 lbs. pressure. It is probable that when running at full speed, these engines are capable of giving out 700 horse power. This power has all to be produced in one boiler and the engine has to carry its coal supply, its water supply and its chimney. What a saving in some respects there would be if the trolley system were used.

IN Toronto the other day an old gentleman undertook to disembark from an electric car while in motion. Result his leg got under the wheels and was completely cut off. The account of the accident which appeared in the daily papers was headed "The Cruel Trolley." It should have been headed "A Foolhardy Act." It is full time that the press and a section of the public should cease to charge to the trolley system calamities which are due to lack of discretion on the part of those making use of electric cars.

X

THE value of mica as an insulating material is creating for it a large demand on the part of manufacturers and users of electrical apparatus. Canada fortunately happens to be one of the few localities where deposits of this material are found. In the provinces of Ontario and Quebec exists in abundance. Now that its value has become apparent, there is an eagerness displayed by local and foreign capitalists to secure control of these Canadian deposits, which will doubtless yield handsome profits in the near future to the owners.

THE conspicuousness to be secured by advertising matter attached to telegraph poles leads wide-awake patent medicine and other business concerns to constantly seek to obtain for their announcements this coveted position. These announcements, like Jonah's gourd, spring into existence in a night, and poles that the previous evening bore no inscription, blazon forth next morning the merits of somebody's liver cure. The alertness of the telegraph companies' officials suffices to reduce the evil to a considerable extent, but seems powerless to entirely prevent it.

CANADIANS have been accustomed to congratulate themselves on their freedom from destructive cyclones such as are of frequent occurrence in some parts of the United States. The grounds of their gratulation have been severely disturbed, however, by wind storms of hitherto unknown severity which have lately swept over this country, the last of which occurred about ten days ago and caused great destruction of property. These storms entail heavy damage on telegraph and telephone poles and wires, and should they prove of frequent occurrence will no doubt hasten the adoption of the underground system.

METHODS of saving coal are numerous, too numerous to mention. One, however, deserves a brief notice. For some time past packages of a mysterious compound have been for sale which was guaranteed to effect a saving of from 15% to 40% by merely dissolving it in water and sprinkling on the coal before putting it in the furnace. It was sold in paper packages at 25 cents per package. It has recently been discovered that the wonderful compound is crushed rock salt, worth about as much as the paper in which it is put up, rather less than more. Its value as a fuel saver, resides very largely in the water used. Let us have bottled sea water next. Perhaps it is to get fuel saving mixture for their locomotives that the C. P. R. Co. have sunk the salt wells up near Windsor.

ACCIDENTS from the bursting of fly wheels still continue, and probably will so long as wheels designed for use with slow speeds are put upon high speed engines. It has been estimated that for a cast iron rim of solid metal, the bursting strain produced by the centrifugal force will equal the tenacity of the metal when the velocity of the rim is about 430 feet per second. If there be joints in the rim, the strength of the joint must be found, as it may be much less than that of the solid rim. A factor of safety of 10 should be used, which will reduce the highest safe speed for a solid cast iron rim to about one mile per minute.

MENTION was made in the ELECTRICAL NEWS for May of the fact that according to the provisions of the Railway Act, a street railway becomes in the eye of the law a railroad when horses are discarded and electricity is adopted as the propelling power. The Customs authorities were brought to a recognition of this fact recently when the Niagara Falls and River Railway Co. brought suit to recover $4.320 paid in duty on rails imported from England on the ground that the tariff provides for the free entry of steel rails weighing not less than 25 pounds per lineal yard, for use in railway tracks. The Crown at first contended that electric "railways" should be classed as "tramways," but subsequent to the trial abandoned this contention, and consented to judgment being given for the amount sought to be recovered.

POOR economy in the operating of an electric light or power plant is that which saves a few dollars in wages but allows dirt to accumulate and general disorder to become part of the plant, so much so that a break down or some similar occurrence eventually happens, which then costs infinitely more to repair or renew than it would otherwise have done. Let it be understood that we are not opposed to the strictest economy possible on the part of those who are the responsible heads of electrical companies, for in this economy the dividends are sure to appear. What we have reference to is that parsimonous economy that is sometimes used to produce large profits at the expense of the good running and perfect maintenance of the plant. Nor is it good policy in constructing a plant to pursue economy to such a point that with the expenditure of a few more dollars the work might be done in a more substantial manner such as would save a lot of expense in the future care and running of the plant. We have in mind a large station that for fine work and expensive construction up to the floor line could not be improved upon, but from that floor line to the roof consists of a flimsy frame and iron structure that is bound to cost more to keep in order than if built with brick or stone walls and an iron roof, not to say anything of the danger of fire wiping it entirely out of existence. Had the construction been of the reverse order, fire could not find anything to start with or feed upon, hence a lower rate of insurance, less repairs, and last but not least, considerable less anxiety and worry for fear of fire. It would not then be necessary to dot the place all over with fire extinguishers, the cost of which could have been much better employed in buying bricks and mortar.

HIGH tension transmission of power from the Niagara Falls will soon be an established fact, if the assurance of those having the matter in hand is to be relied upon. We particularly refer to the scheme to furnish power to the manufacturers of Hamilton as put forth by Mr. John Patterson, of that city. The promotors of the undertaking now promise that within a month they will commence putting up a pole line and stringing wires for this purpose. That they have every confidence in the success of their scheme there can be no doubt, they having already offered the power at a price per H. P. to several of the larger concerns who are now operating steam plants. They do not specify as yet whether they will operate two phase, three phase, or single phase motors. The power to start with will be taken from the American side of the falls until the tunnel on the Canadian side is finished and in working order, when it will be transferred. It is proposed to use step up and step down transformers and a pressure of 17,000 or 18,000 volts on the mains. We are not at present in a position to give particulars relating to the class of construction that they will employ, or as to the nature of the precautions that will be taken to keep their high tension currents on the wires, but our readers shall know all that it is possible for us to learn as the work progresses. We are well aware that some of our best and most prominent electrical men are skeptical as to the successful carrying out of an undertaking of this kind, but if this line is constructed—which now seems certain—and works properly, their skepticism must vanish, whereas if it is a failure their doubts will be more firmly rooted than ever. Of this fact we are firmly convinced, that if it is possible to carry power from the Falls to Buffalo—and we are told that they are already constructing the line to that city—it is equally possible to carry it to Hamilton, which is only a few miles more distant from the source of power. It is now rumored that a company has been formed in New York State with a capital of $10,000,000 with the avowed purpose of carrying power by means of buried wires to all important cities in New York and even as far as New York City itself. This of course, from the present standpoint, seems preposterous, but in this age of electricity who shall say that it will not be a possibility in the near future.

THERE are many villages and small towns within close range of one another that might form a combine of some sort and have themselves supplied with electric lighting, the current being generated in one of them and carried by means of wires, etc., to the others. This would be especially feasible if one of them should happen to have a small water power, or if not sufficient water to run a turbine, at least enough to use for condensing purposes. In either case power would be produced at a cheap rate, and sold by the parties operating the plant at a nice profit. The wonder to us is that there are no plants in operation under such conditions, it being such a simple matter to both equip and operate them. Not only does this apply to arc lighting for street service but to incandescent lighting for house service as well. With the high tension alternating system such lighting can easily be carried a distance of a few miles at a very little loss, particularly as such lighting would only be required from shortly before dusk in the evening until midnight, when the dynamo would be stopped, differing in this respect from large cities where the run is constant for the 24 hours of each day. The pole line could be constructed at a comparatively small cost, as small poles on country roads answer as good a purpose as large ones. The fact that such poles can be obtained frequently at a very low price is decidedly in its favor. There would not be required the preciseness and care in line building that is necessary where a multiplicity of other wiresare met with, as in cities. This would tend materially to lower the cost of construction. Expensive hangers would not be needed for the lamps, the main object being to have them put up in a good and strong way, so as to be able to resist windstorms and such like. The wires would be required to be well put up for similar reasons. The size of arc adopted should be 1000 or 1200 c.p. both in stores and in the streets, a single lamp using 7 16 in. carbons being sufficient for the purpose on account of the service not being required later than midnight. One man with ordinary intelligence could be taught in a very short time to operate the plant, from the trimming of the lamps to the running of both engine and dynamo. A plant of this kind operated in connection with some manufacturing business already established could undoubtedly be made a paying business.

THE recent decision given at St. Louis in the now famous Edison Lamp Case, will no doubt have a marked effect on the Incandescent lamp industry in the U. S., and while being a decided set back for the would be monopoly, its effect as regard lamp users both in Canada and the United States will be decidedly beneficial. On this side of the line lamp users were beginning to feel the effect of the closing up of several factories in and about Boston and Chicago, to overcome which some of them have even gone so far as to import lamps from Germany, with what result we are yet unable to say, except that we know there was a saving in price of about 25 per cent. This saving is of great importance to a plant renewing say from 5000 to 10,000 lamps a year, if the life of a lamp is, as represented, 600 to 800 hours. But now that a decision adverse to the monopoly has been given, users will be enabled to purchase again at the old figures. What the effect of a confirming decision on this side of the line would be it would be hard to say. It seems to be the popular opinion that the patents in Canada are not worth the paper they are written upon, notwithstanding the fact that a decision given some time ago by the Assistant Commissioner against them was reversed on a re-hearing before the Commissioner in Chief. This fact however would have little or no bearing on the case should it ever be taken into the Courts here and decided entirely on its merits, for while the Canadian patent laws are proverbially not the most strict in existence, yet to live up to them there can be no importation of other then raw materials. The question then would hinge on whether the importing of the glass bulb ready for the fusing in of the filament and the importing of filaments ready for mounting, not to say anything of the occasional bringing in of a batch of complete lamps, would constitute in the eyes of the law, the importation of raw material only. We certainly think it would not, but the vagaries of the law are such as to make one wary of passing a positive opinion under these conditions. That the owners of the patents did on various occasions import finished lamps and that they still continue to import both bulbs and filaments is we understand an open secret with quite a number of individuals connected in one way or another with electrical matters in Canada, but aside from all this, our opinion is that they will never press their claims here. In fact only as far back as a couple of months ago they had not succeeded in producing a 50 volt lamp that could be classed as a commercial article, for while giving full candle power to start, they in many cases dropped off fully 75 % in the course of 300 or 400 hours burning. There can be no question but that the incandescent lamp is anybody's property both in Canada and the United States, and that lamp users generally owe a debt of gratitude, if nothing else, to Mr. Rhotehamel, President of the Columbia Incandescent Lamp Co. of St. Louis, for the active manner in which he pursued and carried to a successful issue a defense remarkable for its clearness and conciseness, which we feel sure he was confident would win even before the trial came off.

Deputations representing twenty town and city municipalities waited upon the Ontario Government a fortnight ago to ask for legislation which would enable them to grant exclusive telephone privilegesf or a period of five years in return for a percentage of profits of companies to whom privileges might be given. This step was taken in view of the judicial decision recently given affirming the illegality of such action on the part of municipalities. The petition of the deputation was opposed by the legal representative of an automatic telephone company, which was not a matter of wonder. It was altogether surprising and amusing, however, to see a delegation from the Toronto Trades and Labor Council present in opposition to the granting of the required legislation. The telephone has been properly termed a natural monopoly. One efficient telephone company in a town or city is more satisfactory to the public than two or more companies would be. The existence of more than one company makes necessary the renting by every telephone user of as many instruments as there are companies in order that he may be in a position to communicate with every other telephone user. This means additional expense and trouble. It means, so far as the companies are concerned, that they will be unable to make a fair profit, and consequently will not be in a position to pay any tribute to the municipality. Thus it is that with exclusive privileges granted to one company, telephone users get a better and more efficient service, the telephone company is able to make a fair profit, and the municipality is enabled to exact in return for the exclusive privilege, a considerable percentage of the net earnings of the company with which to lighten the rate of municipal taxation. Strangely enough, there are found people like the Trades and Labor Council, who, while always complaining of their condition, will refuse to allow anybody to assist them in paying their taxes. The Legislature, like a wise parent, saw where these short sighted people's interest lay, and granted the municipalities the power they sought.

PERSONAL.

Mr. L. H. Packard, of Montreal, has been elected first vice-president of the International Y. M. C. A.

Mr. William McKenzie, president of the Toronto Railway Co. has returned from a trip to Egypt and the Holy Land.

Peter Fairgrieve, formerly an employee of the Bell Telephone Co., London, died of consumption, at his parents' residence, Detroit, on May 15th.

MOONLIGHT SCHEDULE FOR JUNE.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1......	P. M. 7.50	P. M. 10.40	2.50
2......	" 7.50	" 11 30	3.40
3......	" 7.50	A. M. 12.10	4.20
4......	" 7.50	" 12.40	4.50
5......	" 8.00	" 1.10	5.10
6......	" 8.00	" 1.30	5.30
7......	" 8.00	" 1.50	5.50
8	" 8.00	" 2.20	6.20
9......	" 8.00	" 2.40	6.40
10......	" 8.10	" 3.10	7.00
11......	" 8.10	" 3.30	7.20
12......	" 8.10	" 3.30	7.20
13......	" 8.10	" 3.30	7.20
14......	" 8.10	" 3.30	7.20
15......	" 8.10	" 3.30	7.20
16......	" 9.20	" 3.30	6.10
17......	" 10.00	" 3.30	5.30
18......	" 10.30	" 3.30	5.00
19......	" 10.50	" 3.30	4.30
20	" 11.10	" 3.30	4.20
21......	" 11.30	" 3.30	4.00
22......	" 11.40	" 3.30	3.50
23......	" 11.50	....	3.40
24......	....	" 3.30	
25......	A. M. 12.20	" 3.30	3.10
26......	" 1.10	" 3.30	2.20
27......	" 1.50	" 3.30	1.40
28......	No light.	No light.	....
29......	No light.	No light.	....
30......	No light.	No light.	....
		Total,	133.00

SPARKS.

Messrs. A. A. Wright & Co., of Renfrew, have purchased an incandescent lighting plant.

Messrs. Anderson & Goddard, dealers in electrical supplies at Ottawa, have dissolved partnership.

It is announced that work will commence immediately on the construction of the Kingston electric street railway. The rails for the road are said to be on the way out from England.

The unusual rise of the Ottawa River recently gave occasion for much anxiety at Ottawa, as the water threatened to submerge the power plants of the electric railway and lighting companies. Fortunately, these apprehensions were not realized.

A company exists at Calais, N. B., with the object of constructing an electric railway five and a half miles in extent through the streets of that town and of St. Stephen which lies directly across the river. Negotations are already in progress for the necessary poles and sleepers.

The Order of Railway Telegraphers of America spent a week in Toronto early in May in the consideration of matters affecting their organization. They were welcomed to the city by the mayor, and although sticking close to business, managed to see a good deal of the city and to all appearances enjoyed their stay among us.

The Ottawa Street Railway Company announce that they will immediately set about converting to the electric system the present horse car line between New Edinburgh and the Suspension Bridge. An order has been given for 750 tons of rails for the purpose. The work is expected to be complete by the middle of August. Ornamental iron poles will be used. The cost of building and equipping the new road is estimated at $118,000.

Mr. John Patterson, projector of the Hamilton radial electric railway, says that Siemens & Halske have been granted the contract for supplying the wire and electric machinery and plant necessary to convey power from the Falls to Hamilton. Work will be commenced at once, and by October the company will be prepared to supply power. The company expects to supply power to the Hamilton Electric Light Company and the street railway. The construction of the radial road will not be commenced until next year, as under the company's charter it has not the right to expropriate. Mr. Patterson has advertised for 1,600 poles to be used in stringing the wires between Hamilton and the Falls.

The Canadian General Electric Company have bought out Hunt Bros,' electric lighting and power business at London Ont., and will make it the nucleus of their new plant and business in that city. Mr. Chas. B. Hunt will be in charge of the business. A location has been chosen on the river bank for the new central station which is to be erected. It will be a substantial brick building 171 feet by 52, with six engines of about 1,100 horse power in the aggregate. The arc lighting plant will be placed in the south end of the building, with two engines of 200 horse-power each to drive the dynamos. This part of the building will be two stories, with the repair shops up-stairs. In the centre of the ground floor will be the incandescent lighting and power plant, driven by 700 horse power engines. The boilers and furnaces are to be in the other end.

RULES FOR FINDING PROPER DIMENSIONS OF STEAM PIPES.

A question that an engineer is very often called upon to consider is whether the size of the steam pipes leading to his engine is sufficient to let through the amount of steam necessary to supply the engine without a considerable fall from pressure. The engineer taking an indicator card, measures the height of his steam line above the atmospheric line and gets at once the pressure that was in the cylinder at the commencement of the stroke and while the engine was taking steam. If this comes within a very little of his boiler pressure he feels more satisfied says the *Journal oj Commerce*, but if, on the other hand, it shows a considerable fall from the pressure in the boiler, he at once asks himself what he is carrying a certain pressure in his boiler for, if it is not to get it into his engine, and looks about to see the cause of the loss in pressure. Naturally the steam pipe is the first object to look at. If it is not sufficiently covered there will be a loss in pressure from this cause, and besides this a loss of heat that represents a considerable loss of fuel as well. An engineer can very readily figure just what this loss from naked steam pipes will be. A steam pipe will lose very nearly three heat units per hour from each square foot of radiating surface of the pipe, for every degree difference in temperature between the steam inside the pipe and the air outside. Suppose he had 50 feet of 6-inch pipe uncovered, carrying steam at 80 pounds pressure, and the temperature of the room was 90°. It takes .57 of a foot in length of 6-inch pipe to give one square foot of heating surface, and in 50 there would be 87.5 square feet of heating surface. At 80 pounds pressure steam has a temperature of 324°, and the difference between it and the engine room would be $324 - 90 = 234$. As $87.5 \times 3 \times 234 = 61{,}425$ heat units, and as one pound of coal is not good for more than 1,000 heat units, this lost heat will require $61{,}425 \div 1{,}000 = 61.4$ pounds of coal per hour, to say nothing of the loss in pressure. It would be quite an easy thing for an engineer to put an indicator on his steam pipe, connect it with the reducing motion of his engine and take a diagram from the steam pipe just as he would take a diagram from the cylinder. This card would show the fluctuations of pressure in his steam pipe and where the piston was when those fluctuations took place. This would prove whether any loss in pressure might be between the pipe and chest or between the chest and the cylinder. If the diagram showed that immediately after the engine piston moved, there was a noticeable fall in pressure in the steam pipe and that this continued until the engine had cut off, then it would be conclusive evidence that the steam pipe was not large enough to supply the demand for steam and keep up the pressure. If, on the other hand, the card showed that the pressure in the steam pipe varied little from that in the boiler, then the diagram would show that any loss in initial pressure in the cylinder was due to the inability of the steam to get into the cylinder, and would show that the ports were restricted in area. A pipe diagram is the surest way of proving this, but it can be approached by means of figures. The best engineers have found that in supplying steam to an engine through a pipe, the steam should not be obliged to move faster than 100 feet in a second. This is to say, that if the pipe was more than 100 feet in length, that particle of steam in the pipe 100 feet from the cylinder should have reached the cylinder in one second. It will make no difference whether the steam is cut off early or late in the stroke, for the steam must move at that rate of speed to fill the cylinder while the valve is open. If the cylinder was required to be filled once in a second—entirely filled, without cut off—it should take all the steam in 100-feet length of the steam pipe in that second. If it is cut off at half-stroke only 50 feet of the length of the pipe will be taken, but that 50 feet has been moved through in one-half of a second and that is at the rate of 100 feet in a second. So with one-quarter cut off, only 25 feet of the length of the steam pipe is relieved of its steam, but it was relieved in one-quarter of a second. The rate, therefore, is the same for all cut-offs, for, if there is less space to fill because of the cut-off, the time in which it is to be filled is lessened in proportion.

It is a fact that the area of the opening of a pipe, multiplied by its length, will give the volume that pipe will contain. Thus a steam pipe having an area of opening of 20 square inches, and 500 inches in length, would contain a volume of $20 \times 500 = 10{,}000$ cubic inches. Dividing this volume then by its length will give the area of opening of pipe. If we know, then, how much volume of steam must be supplied to an engine in a second, and wish to put it into a pipe 100 feet long we have only to divide this volume by 100 and get at once what the area of the pipe must be to contain this volume of steam. We will have then a volume of steam in 100 feet length of the pipe just equal to what the cylinder demands, and the steam will therefore move at the rate of 100 feet in a second.

If the engine makes 60 revolutions a minute, then the piston makes two strokes in a revolution, or one second, and the cylinder must be filled twice in this second. Multiplying the area of the piston by its length will give the volume to be filled in one stroke, and by 2 will give the volume to be filled in one second. If the engine moves 90 revolutions per minute, then this is 1½ revolutions a second, or three strokes, and this must be the volume to be filed, the space swept through by the piston in three strokes. The proper way to figure this is to multiply the area of the piston by the number of feet the piston moves through in a second. Suppose an engine of 42-inch stroke, and running 66 revolutions a minute, or $2 \times 66 = 132$ strokes. Then 42 inches equaling 3½ (feet) × 132 (strokes) = 462 feet in a minute, divided by $60 = 7.7$ feet a second. Multiplying this by the area of the piston in square feet gives the volume swept through by the piston in a second, and this volume must just equal the area of the steam pipe times 100 feet long. All there is, is to get a steam pipe large enough so that 100 feet of it will just equal the volume swept through by the piston in a second.

The rule is as follows: To find the proper area of steam pipe, multiply the area of piston in square inches by the piston speed in feet per second and divide by 100. Quotient is area of steam pipe in square inches. From this area the diameter is obtained by well-known rules.

There is a loss in pressure at the elbows and through globe valves, but this may be disregarded unless there are more than five of them, in which case they will produce a loss in pressure in the friction of the steam passing through them.

It will be seen that if this is the proper area of a steam pipe, the area of the port should be just as much. It is here that the difficulty comes. The port should be open to an amount that will equal this area by such time as the piston, starting from a state of rest, gets to a movement equal to this rate of speed per second. The object of all recent improvements in Corliss engines has been to open the port nearly the full amount at the commencement of the stroke and to cause the valve to move slowly until cut off. No good valve gear will have such a motion that the port is slowly and gradually opened. What it needs is a quick opening of the port at the start, and valve gears that will not give this quick opening are defective. When there is a fall in pressure between the steam pipe at the chest and the cylinder, this insufficient opening is the cause, and it will be found that the valve is slow in opening, or sometimes it is the case that the ports are too small. A valve can be set so that the opening will be slower than at other times of setting. This should not be. We will touch on that matter after. In figuring for the exhaust pipe and port, the steam should not be required to move more than 75 feet in a second. In the rule, therefore, divide by 75 for the exhaust pipe instead of 100 as for the steam pipe.—*Scientific Machinist.*

So far as invention is concerned, says the Canadian *Patent Review*, attention seems to be more and more concentrated on electricity. In the December 1891 issue we published a few lines anent the paucity of electric heating, and it is a striking coincident that one of our worthy fellow citizens should since have procured patents for about a dozen different inventions of that ilk. A drug store, only a few doors from this office, is being exclusively heated this winter by electricity, a battery of five heaters circulating the water through the coils and keeping the place warm even if the mercury hovers about the lower forties, as it is recently reported to have done. The electric street cars are made comfortable in the same manner, lumber kilns and green houses are worked similarly, bread has been baked in electric ovens and a numerous party sat down to a dinner with elaborate menu, everv morsel of which had been cooked by electricity. But practical every day house warming by electricity, is still a luxury which only the proverbial millionaire may enjoy, unless current can be obtained at a mere nominal price. Current is or ought to be cheaper in this city than elsewhere, but still it cannot be bought commercially at $10 per horse-power. So there is still room for improvement. The primary battery is still an unsolved problem and so is the secondary, or storage battery, as far actual commercial demonstration is concerned.

ELECTRIC MOTORS.

By Geo. D. Shepardson.

There are many interesting points about the operation of electric motors. A number of books and many articles in the papers give a good discussion of the dynamo, but when it comes to the motors we cannot say quite so much. Writers generally presume upon so much previous knowledge that one who knows little of the subject finds it difficult to follow them. There are a number of interesting points about the operation of motors that puzzle even "experts." Some are comparatively easy to solve if one is adept in higher mathematics. There are others that one can understand without much need for mathematics if they are only explained in simple language.

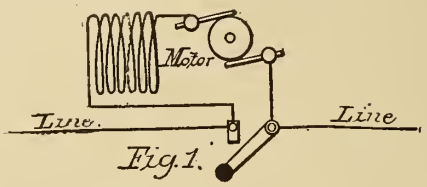

Fig. 1.

The writer has been working with motors of various sorts for a number of years and in a series of articles in the *American Mechanic* he expects to discuss some of these points in a way that he hopes will prove of interest to many. Questions and criticisms will be welcomed at all times and from any source.

In order to save time let us suppose that we have a motor ready to be wired up and put to work. Then while this is running and paying for itself, we will consider what it is doing and what it might do. Motors for direct currents may be classified as series motors. The field magnet coil is wound with coarse wire and is connected in series with the armature so that the whole of the current passes through them both. In the shunt motor the field coil is wound with many turns of fine wire so that it has a resistance three or four times that of the armature. In the shunt motor the current divides, a small part of it going through the field coil while nearly all of it goes through the armature. Motors for arc light or series circuits are always series machines and generally must have some mechanical regulator. Motors for constant potential circuits may be either series or shunt according to the work which they are doing.

Motors for arc light or "series" circuits are connected into the circuit in the same way as arc lamps. Some of them are provided with a simple switch that short circuits the motor as shown in Fig. 1. It is preferable to use a double pole switch in order to cut the motor entirely out of the circuit when not running. This is for the purpose of safety, in order that one may not be liable to get a shock from the motor in case the line was grounded. The method of connecting by a double pole switch is shown in Fig. 2 To start the motor this switch is opened, thereby throwing the motor into circuit. No rheostat or resistance is needed since in no case can the current through the motor become greater than that in the main line and this is kept approximately constant by the dynamo.

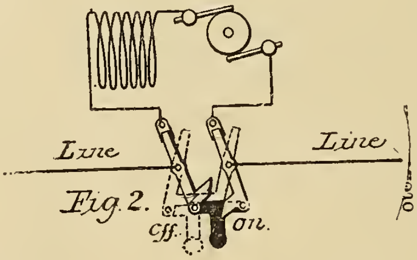

Fig. 2.

On starting up a motor on a constant potential circuit, it is necessary to have a certain amount of resistance in series with the armature in order to prevent an excessive current from flowing. As the armature comes up to speed it develops a higher and higher counter-electromotive force which opposes the electromotive force of the line and so regulates the amount of current passing through the armature. When series motors are used on constant pontential circuits, as is the case with the electric railway motors, a variable resistance is connected between the motors and one of the mains. The other terminal of the motor is connected to the opposite main, as shown in Fig. 3. In this case also it is better to use a double pole switch.

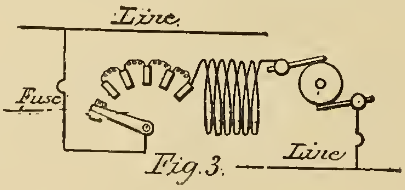

Fig. 3.

Series motors are not self regulating on constant potential circuits and are not suitable where constant speed is desired. In such cases shunt wound motors are preferable and are generally used. These are connected up, as shown in Fig. 4, so that the field circuit is complete when the switch is first closed. The armature circuit is then closed through a variable resistance which is gradually cut out of the circuit as the armature comes up to speed. This leaves two separate circuits through the motor, the field and armature, each being connected directly across the two mains, each taking its own current.

It is sometimes desirable to reverse the motor so as to make it rotate in an opposite direction. This is accomplished by changing the direction of the current through either the field or the armature. If we reverse the current through both the field and the armature, the armature will run the same direction.

There are some other interesting points about the regulation of motors. It is well known that motors will of themselves regulate the amount of current, taking more or less according to the work to be done, the speed being kept nearly constant all the while These points will be left for a later article.

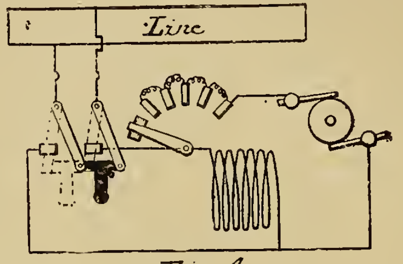

Fig. 4.

CONDENSING BY AIR.

The author, having been led by the rise in the price of coal to adapt a condenser to a non-condensing steam engine of 70-horse power, and being unable to obtain a fresh supply of cold well-water for more then ten minutes at a time, was obliged to resort to the principle of artificial cooling in order to use the same water continuously. After discussing several methods, such as cooling tanks, open gradation works, and others, he describes the plan adopted, which is to divide the hot water into narrow streams, which fall through a system of vertical channels against a rapid current of air, moving in the opposite direction. In the first form the apparatus consists of a rectangular wooden tower 7.5 metre high, 1.9 metre long and 1.3 metre broad, the upper half of which is divided into narrow passages by twenty-six boarded partitions spaced 10 centimetres apart, while the lower half is in air chambers supplied by a fan with spiral blades 1.2 metre in diameter fixed in one of the sides. The water to be cooled is delivered from a pipe at the top and passes through the intervals between the boards against the upward current of air, which moves at about 6½ metres per second. The effect is two-fold; the air acting partly by directly absorbing heat and partly by evaporating and absorbing water vapor, the relative value of these two factors being different at different times of the year. In winter the air works principally by direct cooling, but in summer, when its absorptive capacity for vapor is increased two and a half fold, the cooling is mainly due to evaporation; the final result being tolerably constant throughout the year, the vacuum in the condenser varying between 70 and 73 centimetres of mercury. The cooled water is reserved entirely for condensing, being too greasy for feeding boilers, so that it is constantly receiving new water in the discharge from the condenser. Theoretically, therefore, this should give some increase of volume in the circulating water after allowing for evaporation to the air, but in practice it is found that the quantity is constant, except occasionally on the coldest days of winter, when a small amount is sometimes run to waste from the collecting cistern, which is placed underneath the air chamber.

A curious consequence of the use of the same water over and over again for condensing is that a higher vacuum is obtained from it than might be expected from its temperature. Thus, in five comparative experiments, the same reading of the vacuum gauge (70 centimetres) was obtained with the same water, returning at intervals of ten minutes to the condenser as with fresh well water; the temperature in the former case being 27° to 28° C., and in the latter 12° to 13°. This is due to the circumstance that the rapid circulation causes the injection water to be practically free from air, while in the case of spring or other natural waters the air pump has to remove the dissolved gases, and thus a worse vacuum is obtained than with distilled water. It might be supposed that the intimate mixture of water and air would lead to reabsorption of the latter, but this does not take place, partly from the short time of contact, but more particularly from the circumstance that the energy promoting separation of air in the air pump is measured by the pressure of the atmosphere, or 10,300 millimetres, or one-two-thousandths part of the former.

The space required for the apparatus is only about one-one-hundredths of that of a cooling pond; a surface of 3.5 square metres being sufficient for 100-horse power, that of the boards being calculated at 3 square metres per horse power. The air pressure is 5 millimetres of water, the velocity is 6.5 metres per second, and the volume required about 2000 times that of the water, with 2 per cent. of the latter being absorbed as vapor. In order to promote intimate contact between air and water, it is found to be better not to use boards in single lengths of the full height of 6 metres, but to divide them, placing the lower half at right angles to the upper one, whereby any dry kernels of air from below are brought into contact with the wet surfaces in the upper part. Care must be taken to lay the water onto the boards so as to flow smoothly over them and to prevent all spiriting. The cooling effect of the apparatus when the boards are placed horizontally is only one-half of that of the vertical form.

The wear of the apparatus is very small, the fatty matters brought over by the condensed steam are partly deposited in fine films on the surface of the boards, and protect them from rotting, while the remainder collects on the surface of the water of the tank and is collected at intervals of two months for conversion into wagon grease. The load on the engine is increased by about 3 per cent. by the work of the fan and from 1½ to 3 per cent. by the circulating arrangement, which may be effected by the air pump directly or by a centrifugal pump. As the advantage gained by condensing is about 30 per cent. in an engine of moderately good quality, the net saving is about 25 per cent. Numerous examples of the application of the method to engines of different kinds are given in the paper. It has been adopted or is in course of construction in thirty-five different establishlishments, the largest example being on a central condensing plant for engines of 2500-horse power, at the iron and steel works of Dudelingen, in Luxemburg —[Inst. C.E.

ELECTRICAL RECORDING METERS.*

By Carl D. Haskins.

I propose to briefly describe and discuss the leading elements which, singly or combined, have gone to make up the typical meters presented to the public up to the present time. I find myself limited to generalities, and the mathematical theory and strictly technical considerations have necessarily been neglected that the field might be approximately covered.

The earliest meter patent was granted in 1872 to Mr. S. Gardner of New York City, and the principle of a magnetic or electro magnetic release for a simple clock movement is preserved in two or three so-called time-counters to-day and is doubtless very useful for many purposes, as for example in the Spaulding clock for registering the hours of use of a motor, or other similar devices of registering the hours of use of arc circuits. These devices I shall neglect; they are not meters within the true sense of the word, and their simplicity is obvious.

The earliest successful meters, if we consider classes rather than individual instruments, were the chemical meters, closely followed by thermo-meters.

The chemical meter is obviously capable of giving most accurate results: in fact with proper manipulation, it is very doubtful whether any measuring device which has up to-day been designed could more correctly sum up passing power. It is in the manipulation and care which such meters require that their fault lies—if fault there be.

An electro-plating bath in its meter form as generally used does not, however, give a dial indication, and the consumers ask for a dial indication almost invariably, unless they have already become thoroughly familiarized with Edison meters as used by many large Edison stations.

Many very ingenious and some quite successful attempts have been made to actuate a train of gears by the electro-deposition of an electrolytic bath. Thus we have two electrodes suspended at the opposite ends of a walking-beam, as shown in Fig 1. This walking beam is in various ways connected with a pole changer, and as but a small portion of the current being measured passes through the true meter (for of course almost all chemical meters are shunted) the pole changer is not perhaps a very serious objection.

The action of such a meter as this is obvious; we have a deposit from one electrode onto the other, until the second electrode becomes the heavier, when the beam tips and the recording device is set one notch ahead, the pole changer is thrown over, and the deposit takes place in an opposite direction, the former plus electrode becoming the minus, and so on. This device deposits and redeposits the same zinc, or rather electrode material. Again we have a modification of the same device in the form of a wheel bearing a number of electrodes, and on the same principle setting up continuous rotation.

It should be noted that in this first digression from the chemical meter we at once meet with the prime factor of difficulty in all motor meter construction—that of friction, which, if uncompensated, must invariably introduce more or less serious error.

Another form of self-registering electrolytic meter has a cathode plate suspended from a spring balance, an ordinary sensitive spring weighing machine, and the heavier the cathode grows so much greater is the registration of the spring indicator. This device is perhaps preferable to the reciprocating movement just described, but is limited in the capacity of the spring, and probably lacks sensitiveness to small amounts, being dependent of course solely upon the nicety of construction in the spring balance.

Mercury has at times been employed in the construction of electrolytic meters, and with at least moderate success, for with a mercury anode and a cathode of the same or other material, a record easily measured may be obtained, and such a meter may even be made self-registering in a graduated tube or by half a dozen other more or less simple means. Such are the more typical electrolytic meters.

Another form of chemical meter formerly quite popular among inventors depended for its registration upon the decomposition of water, generally acidulated water, and sometimes upon the decomposition of more volatile substances. This class of meter may very properly be divided under two heads:

First, those meters simply dependent upon the measurement of the gas developed by the decomposition of water through any gas registering device. In fact we may say that such meters are mere decomposing baths connected to a gas meter. There are some devices of merit which may be classed under this head, but the principle is probably not commercial, for we have nothing very successful of this kind in use to-day.

One of the more ingenious meters of this kind provides a diagonally placed rotating wheel with pockets; the decomposition takes place directly under each pocket progressively, and as the air pocket fills with gas the wheel rotates sufficiently to free this gas at the surface of the fluid, bringing another pocket into place. Others have a rising and falling diaphragm like the popular gas meter, and still others a delicately poised air fan over a minute aperture. This last device is obviously most inefficient.

The second group of meters under this classification bring us to the thermo-meters, a typical group containing a few meters of more or less pronounced merit.

Those thermo-meters depending upon volatization of a fluid generally have two or more sealed bulbs partly filled with some volatile fluid, as for example, naphtha or ether. When two such bulbs are used, they have generally been mounted on a walking-beam mechanism combined with a pole-changer, each bulb containing some kind of a rheostat or heat developing device dependent for its heat on the current passing through the meter, the two bulbs communicating with one another. The rheostat in but one bulb is in circuit. The heat developed in the rheostat in circuit volatilizes more or less rapidly the fluid contained in this bulb, according to the current passing through it. The gas developed either passes in gaseous form into the second bulb and condenses, or else, as is more common, forces the fluid remaining by the simple increase of pressure into bulb No. 2, which at once becomes heavier and causes its end of the beam to fall. This throws the pole-changer, and the rheostat in the second bulb is thrown into action, repeating the operation as just described. To be successful, such a device must be very sensitive, and to be sensitive, the construction must be of a more or less expensive character and so delicate as to be to a greater or less degree prohibitive. Like the walking-beam meters just described, instruments of this class have been designed with a number of bulbs mounted on a rotating wheel; the same actuating principle holding true for all such devices. Another ingenious form of thermo-meter, no longer in any sense a chemical meter is an instrument dependent for its action upon the heat in a confined but circulating atmosphere. Thus a rheostat dependent for its heat upon the amount of current passing is so arranged as to heat a body of air, which by the peculiar construction of its receptacle, at once commences to circulate more or less rapidly, dependent upon the heat. It is obvious that if a delicate air fan, a screw propellor in fact, be suspended over such a circulation of air, its speed would increase with the speed and volume of circulation, and one of the most ingenious and most interesting meters that it has been my good fortune to see is the Forbes meter constructed on this plan. But here friction is the most serious consideration, the torque obtained in this manner being necessarily small.

While the Forbes meter cannot perhaps be properly considered as a motor meter in the true sense of the word, it still must be classed as such in a certain sense, and I think it may safely be accepted as an axiom that to be successful in practical operation a motor meter of any kind must be of high torque, for it is only by the combination of high torque and compensated friction that accurate results can be obtained on light loads. I might say that almost any one can build a meter which will record fairly accurately on heavy loads; the difficulty is to build a sensitive and accurate meter for very light loads down to one lamp.

SPARKS.

The by-law to guarantee $400,000 bonds to the Vancouver Tramway Co. was defeated at the polls.

Electricity will shortly be applied to the working of the New Curran bridge, over the Lachine Canal, Montreal.

The Berlin and Waterloo Street Railway Co. has been authorized to construct works for the production of electricity.

At the recent examinations in connection with the Toronto Technical School, the following were the successful candidates in Electricity:—R. C. Plewman, J. W. Lawson, A. W. McCullough, A. Goode, and James Patterson.

President Myles, of the Hamilton, Grimbsy and Beamsville Electric Railway Co., recently stated that if the City of Hamilton did not grant a bonus of $30,000, the road would not be built. The projectors asked the city to take $50,000 stock and waive dividends for 15 years, but the application was not granted.

Her von Siemens, of the firm of Siemens & Halske, has arrived in New York and it is said will be in Hamilton shortly in connection with the project of the Hamilton Radial Electric Railway Co. for the transmission of power from Niagara to Hamilton. Should he concur with the high opinion held by the managers of the firm's branch factory in Chicago, it is probable that a large plant will soon be erected in Hamilton.

The Bell Telephone Co. has been authorized to issue $440,000 additional stock, making the capital $2,640,000. In a circular issued recently by C. F. Sise, President of the company, it is stated that each shareholder of record of date of circular, will be entitled to take at par, shares in the new stock in the proportion of one share to five shares of old stock held, until 2 p.m. June 1st. The balance of new stock shall then be disposed of as the directors may determine.

The City Railway Company of Windsor (Ltd.), have been incorporated for the purchase, construction, equipment and operation of a street railway in the city of Windsor, the towns of Walkerville and Sandwich, and the townships of Sandwich East and Sandwich West. The Company consists of John Coventry, John Davis, Wm. J. McKee, Wm. J. Pulling and James Anderson, of Windsor, Geo. M. Hendrie of Detroit, and Robert Thompson, of Hamilton. The capital stock of the Company is $250,000.

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* Abstract of a paper read at the Seventy-third Meeting of the American Institute of Electrical Engineers, New York, January 17, 1893.

ELECTRIC RAILWAY DEPARTMENT.

SELLING POWER FROM TROLLEY CIRCUITS.

The number of railways selling power from their trolley circuits is surprising to those that have not investigated the matter says the *Street Railway Review*. The business has grown in a quiet way, generally requiring little effort on the part of the road, and so it has attracted but little attention. We could name a half dozen roads within 100 miles of Chicago that have a good income from this source.

They are many reasons why the average electric road can sell power from its trolley circuit more cheaply than the electric light stations in the same town. In the first place the power business in the majority of moderate sized towns, such as the greater part of the electric roads of the country operate in, is either so scattered or so small that it is only at great expense that the lighting companies can handle it. In order to supply these scattered customers, the electric light company has either to install a special high pressure circuit and dynamo for its power work, or to invest in a large amount of copper to bring its low pressure incandescent system to such customers. In either event the result is rather unsatisfactory to the company, and an investment is required over and above that necessary to the regular business of the plant. The running of a small engine and dynamo simply to supply a few consumers with power is liable to be unprofitable either to the company or the consumer. If the power is supplied from lighting circuits, the variations in load on the large motors does not conduce to steady light. Then, too, they are generally plants of some size that want power, but it is impossible to generate electricity and supply it at some distance and make it more economical than direct steam, unless the generating station is very large.

With the railway the case is different. It has an immense power capacity installed and running at the time when it is wanted. Its outlay per horse power of steady power generated is very low. Its lines are strung all over the city, and the ground helps furnish a return, so that the cost of installation is small. In short, what may be a very unsatisfactory business for the lighting companies may be a very satisfactory one to the street railways.

It is not advisable, of course, for the railways to enter into cut-throat competition with the electric light companies, but if the field is undeveloped there are good reasons why the railways can give the cheaper service. Such business generally does its own canvassing when once started.

ECONOMY IN ELECTRIC RAILWAY MANAGEMENT.

THE economy of electric over horse railways became evident very soon after the former were commercially in operation, but there remained a large margin of unnecessary expense in every electric road up to a recent date. Indeed, it is doubtful if any such road, however small or old, has yet reached a condition of just economy. There may be electric roads whose management is penurious, but penuriousness will never prove to be economical for a road in the long run. Among the various means of reducing cost and, at the same time, increasing the efficiency of service is the furnishment of complete information to the employees in regard to their duties, also technical information in regard to their special work. One large road has reduced the number of men employed in re-winding armatures one-half, and without hardship to the men. Similar economies have been accomplished in other departments. This result has come chiefly from the employment of trained electrical and mechanical engineers, who give careful attention to details; while men in charge of the motors and cars are furnished with a book giving clear explanations of the various parts of the car and its electrical equipment, with instructions in regard to their care, and the proper method of repair or procedure in case of accident on the road. Specially trained inspectors are traversing the line at all times, looking after motors that are not working perfectly. In all departments in the shops everything is made to gauge, so as to be interchangeable. Of course, the details of the boilers, engines and generators have, also, been properly adjusted and closely looked after,—greatly to the increase of current to the pound of coal. These improvements in operation tell to a demonstration that its skilful engineers and trained foreman are well worth their salaries to the company—*Electricity and Railroading.*

COST OF OPERATING ELECTRIC CAR HEATERS.

THE Consolidated Car Heating Company, of Albany, New York, has just issued says the *Street Railway Review*, a table giving numerous figures on the cost of generating electrical energy under different conditions. The ultimate object, of course, is to get at the cost of running electric heaters, but the table has some interest aside from this. The course of 1-horse-power hour at the car is given at $0.1335 under the most unfavorable conditions, viz.: with coal at $3 per ton and high speed simple engines. This includes all the operating expenses—taxes, repairs, etc. The cost with triple expansion slow speed condensing engines is given as $.00748 with $2 a ton coal. With the heaters using 8.90 amperes, which is the amount usually required in average winter weather, with the outside temperature between 20° and 0°, the highest cost per hour would be $.03649 and the least $.00943. This table has been compiled by the company's consulting engineer, James F. McElroy, from data given by Charles E. Emery, in the March 1893, Transactions of the American Institute of Electrical Engineers. It is computed on the basis of running 20 hours a day 365 days in the year. The table gives figures on over 500 items and will be found of great interest to those who are getting figures from their own plants as to cost per year of different items.

PRIZES FOR MOTORMEN AND CONDUCTORS.

The directors of the East Cleveland Railroad Company of Cleveland, O., have decided to give the motormen and conductors an opportunity of working for something in addition to their salaries. They have offered $3,000 in prizes for carrying out the rules of the company and avoiding accidents. There will be two awards: one on July 1, 1893, another January 1, 1894. At each award $1,500 will be distributed as follows: Fifty dollars as a first prize to each of ten motormen, and $25 to each of ten motormen as second prizes; $50 to each of ten conductors as first prizes, and $25 to each of ten conductors as second prizes. In order to determine who are entitled to the prizes a careful record of each man's services will be kept, and all accidents and complaints will be noted. The records will be submitted to a committee consisting of one man selected by the company, one selected by the employees, and a third chosen by the two. This committee will make the award of prizes.

MAXIMUM SPEED OF ELECTRIC CARS.

THE published abstract of calculation bv J. Kramer in the *Elektrotechnische Zeitscerift* on the maximum speed for an electric railway is as follows: "The theoretical maximum speed of a perfect motor on rails is taken at 500 kilometres (310 miles) per hour. This is on the level, with curves not less than 20 kilometres (12 miles) radius, and 12-feet driving wheels. The problem of an electric locomotive and two cars is then investigated at length, and the author appears to have considerable doubts whether the proposed 250 kilometres per hour on the projected Vienna and Budapest line of Messrs. Canz is feasible. The author would put the maximum at not more that 200 kilometres (120 miles), if as high."

McFaul's Factory and Dealers Supply World informs us that if a bottle with a glass funnel, in which is placed lumps of calcium chloride, is placed in a case where cutlery, etc., is on exhibition, said cutlery will never rust, as the calcium chloride will attract every particle of moisture to itself, and that part which is dissolved will trickle into the bottle, leaving the solid part intact so that it is useful until entirely dissolved. We suggest that some of our engineer friends, whose engines are located in damp places procure a carboy and fit it up, so that if the statement be true, all of the rust producing ingredients in the atmosphere may be bottled up, instead of settling on the bright work of the engine.—*American Machinist.*

FLUE TEMPERATURES AS AFFECTED BY FIRING.

By David M. Greene, M. Am. Soc. C. E.

In March, 1892, while experimenting with one of a battery of 10 large steam boilers, in a New England manufacturing establishment, a variety of data were observed. Among these were flue temperatures of the products of combustion, as affected by opening furnace doors for firing and for cleaning fires. Believing that the observed facts will be of interest to others, the writer has constructed a series of temperature curves, three of which are furnished herewith.

The boiler was of the ordinary return tubular type, 17 feet long and 6 feet in diameter, with 140 3-inch tubes, 16 feet long. The fire grate was 6′4″ x 6′—38 square feet. Bituminous coal was burned in each case at the rate of 14.26 pounds per square foot of grate per hour, and steam was carried at about 65 pounds by gauge. The products of combustion after reaching the front of the boiler, through the tubes, rose to and passed backward over the top of the boiler to a flue connection at the rear. A high-grade mercurial thermometer was placed in the current of gases at the top, about midway between the front and rear ends of the boiler, which was read at intervals of 30 seconds.

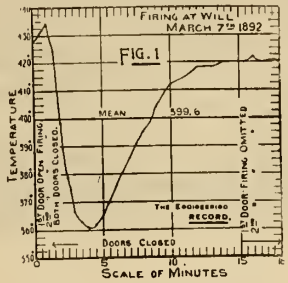
FIG. 1

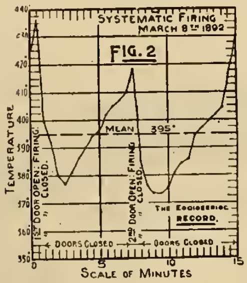
FIG. 2

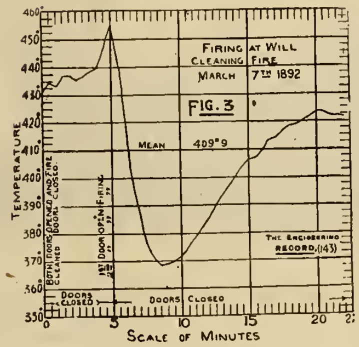
FIG. 3

Figure 1 is the temperature curve due to normal firing, or firing at will. At the end of the second interval of 30 seconds, both doors had been opened, the fire replenished and the doors closed. Observations were continued 18 minutes, about the ordinary interval between firing.

Figure 3 is constructed from observations taken on the same day (March 7, 1892), and shows the effect of opening the furnace doors for the purpose of cleaning fires, as well as for replenishing them. At the end of the second 30-second interval, both doors had been opened, the fire cleaned and the doors closed. After an interval of about three minutes, both doors were again opened and fired, one after the other, and closed again. Observations continued during a period of 22 minutes. On this day, the equivalent evaporation from and at 212 degrees was 10.51 pounds per pound of coal.

Figure 3 is constructed from observations taken on the succeeding day (March 8) when the rate of coal consumption was the same as it was on the 7th; but when an interval of 7½ minutes was required between the firing of the two doors of the furnace. Thus each door was opened and each half of the fire was replenished at intervals of 15 minutes. In other words, half of the furnace was fired every 7½ minutes, and the whole of it every 15 minutes. The temperature curve, Fig. 3, shows the effect of this change. On this day the equivalent evaporation from and at 212 degrees was 10.79 pounds per pound of coal.

The boilers in question constituted a then recent addition to the plant; owing to limited space, however, suitable proportions were impracticable, and the proportions of the boilers were left to the builders, while the settings were in accordance with the directions of the writer.

Discussion of, and further comment upon, the facts presented are purposely omitted. Each interested reader is therefore free to draw his own conclusions.

TRADE NOTES.

Twenty cars are being turned out by the Ahearn & Soper Car Works, Ottawa, Canada, for the Montreal Street Railway Company. They will be equipped with Westinghouse motors and delivered ready for operation on the tracks.

The following letter addressed to the Magnolia Metal Co. New York, by Mr. B. J. Jensen chief engineer of the steamship "Plymouth," of the Fall River Line, speaks for itself: In answer to your inquiry as to our experience with the Magnolia Metal, we desire to say that we have it in the intermediate crank pin brasses of the Plymouth, and it has given us every satisfaction, and from our experience with it we cheerfully recommend it for such work.

The Penberthy Injector Co., of Detroit, Mich., report that they again have their machinery in motion after a delay of ten days occasioned by a fire at their factory on May 9th, at which time their entire third floor and roof were burned, and the stock and machinery on two first floors badly damaged by water. Over 50 carpenters, masons, plumbers, roofers and steam fitters, have put in shape in seven days (three used in insurance adjustment) what looked to be a months work after the fire. They are prepared to fill orders as usual.

The St. Catharines Electric Light Co. have replaced two of their old dynamos by a new one with double their capacity and having all the latest improvements. They will also extend their circuits as soon as they have the power house completed.

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CYLINDER LUBRICANTS.

Some interesting practical experiments were recently made to ascertain the expansion of oils under the action of steam, says an exchange. This point, together with its resistance of intense heat and freedom from acid-producing properties, fixes the value of a cylinder lubricant. Since the universal acceptance of hydrostatic lubricants as the only correct method of feeding, the minimum quantity of oil for a given amount of work can be readily determined. The automatic application of drop by drop, just as needed, preventing the waste of injection pumps and securing uniformity instead of the uncertainty of hand feeding has insured the steam user the saving of many dollars. The mistaken economy of selecting an oil on account of its attractive color or to meet the defects of the oil cup, that from some fault in construction or lack of sufficient pressure will not feed heavier oils, was very clearly demonstrated in the experiments referred to.

In filtered and light-bodied cylinder oils the color is obtained at the expense of the wearing properties. Facilitating the feed at the same time accelerates escape from the steam chest before the oil has performed the work intended. Failing to atomize and thus be distributed by the steam, such oils are blown out with the exhaust, leaving the cylinder without lubrication. Consequently, they must be fed up liberally in order to make up for this failure to disseminate.

There is also a waste owing to their lower fire test and more or less danger from their tendency to burn or bake. The tests also show that an apparent body can be produced by the compounding of foreign substances. To give seeming consistency gelatinous matter is used. This, as well as "fixed oils" and fluid results of animal fat, are not volatile. That is, they cannot be distilled without decomposition. When heated under the action of steam in the cylinder with the alkalies of the feed water, the fatty acids combine with the alkali, producing saponification, while glycerine is simultaneously formed. The effect of such a combination on metals is well known. Their heat only tends to make such substances more adhesive, and utterly failing to atomize, they drop into the cylinder to be worked and churned by the follower of the piston.

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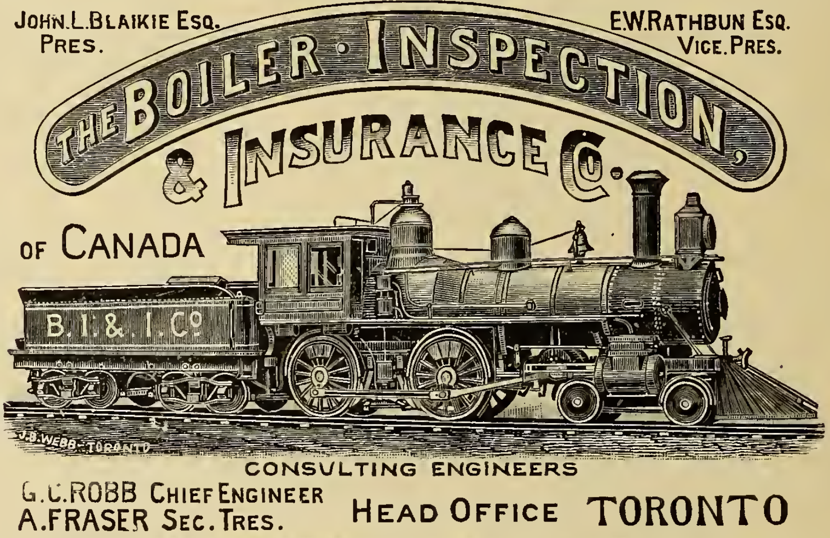
SPARKS.

The Corporation of Fredericton, N.B., has obtained power to issue debentures to the amount of $6,000 for the purchase of an electric plant for street lighting.

It is proposed to build an electric railway from Fredericton to Marysville, New Brunswick, a distance of four to five miles. It is proposed to cross the river by a light steel bridge.

All the cars on the Montreal street railway will now be built by the company at their own shops at Hochelaga. They will also equip, at a cost of $30,000, a shop for the manufacture of their electric motors.

About 70 miles of new electric railway tracking will be laid in and around Toronto, this summer, which will require the addition of 300 cars, Toronto will then have 128 miles of electric tracking and about 530 cars. Toronto has the best operated electric car service in Canada, if not in America.



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Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five-eighths inch wide, and when wrapped about a joint and pressed firmly it makes a solid mass. For railway and Motor use, we make all sizes of stranded and flexible with Clark insulation.

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SPARKS.

The National Electric Tramway and Light Company, of Victoria, B.C., have made arrangements to drive their generators and lighting by means of a water power station seventeen miles from the city. The steam plant will be ready at all times to be put in operation should this power fail.

A Montreal alderman has lately made the threat that unless the Bell Telephone Company agrees to the proposals of the city respecting reduced rates to citizens and a telephone tax payable by the company to the city on each telephone, the city council will proceed to grant permission to the Merchants' Telephone Company to put up poles and string wires.

It is an easy matter says the *Electrical World* to find whether there is a cross connection between a coil and its core, but when the cross is between the wires themselves constituting the coils the usual method cannot be used. For such cases, as also for a number of others a very ingenious and simple method is in use in the Thomson-Houston factory at Lynn, which is well worth the attention of those engaged in constructing apparatus containing coils in which cross connections may occur. It consists simply in placing the coils to be tested in the field of an alternating current coil and noticing whether or not parts of the coil become heated. It is evident that if there is a cross connection between the windings, the turns included between these points will form a short circuited coil in which currents will be induced when placed in this alternating current field, which will cause that portion to become heated. This method, therefore, not only shows when there is a cross, but, if there is one, it to a certain extent locates it. In some cases the coil to be tested is placed in the field with its core and in other cases without. For simplicity nothing more could be desired.

PUBLICATIONS.

The latest arrival in the arena of trade journalism is *The Canadian Engineer*, published in Toronto and Montreal, and devoted to the mechanical, mining, marine, locomotive, sanitary and other branches of the engineering trades. The subscription price is $1 a year. The address is: *The Canadian Engineer* Co., 62 Church street, Toronto, or, the Fraser Building, St. Sacrament street, Montreal.

The June *Arena* is a mammoth number. It is probably the largest magazine ever published as a monthly issue of a review, containing one-hundred and sixty-four pages, of which one hundred and forty-four are in the body of the magazine, and twenty pages of carefully written book reviews of such well-known critics as Rev. W. H. Thomas D. D., of Helen Chicago, Campbell, Hattie C. Flower, Hamlin Garland, and the editor of the *Arena*.

LEGAL DECISIONS.

The City and Suburban Electric Railway Company is being sued by a bricklayer named Mould, who met with an accident from an incoming car while he was repairing the brickwork of the company's power house on St. Clair avenue.

The Toronto Incandescent Light Company's appeal from the judgment given against them when the owner of a horse was awarded $100 for injuries to the animal through falling into a hole on Church street, Toronto, made by their workmen, has been refused. They asked the Court to determine the city to be liable.

The case against the city of Guelph and the he Guelph Gas Company brought by a man named Healy has ended in favor of the defendants. The plaintiff alleged that when returning home one evening he ran against a loop of an electric light wire on a street in Guelph, and received a severe cut. The defendants maintained that the light was lit and that it was impossible to run against the wire as stated.

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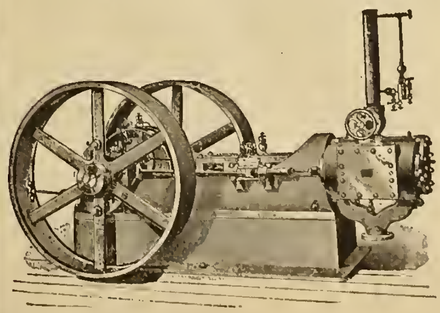

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SPARKS.

A scheme is being agitated for the construction of an electric tramway from Nanaimo to Wellington, B. C.

The directors of the Hamilton, Waterdown and Guelph Electric Railway Co. have decided to oppose the granting of a charter to the Hamilton Street Railway Co. to establish radial electric roads.

The mica business is reported as being good and large quantities are being shipped to England. The Cleveland administration is expected to remove the duty off this material which will further increase the trade.

His Excellency, the Governor-General, recently presented Messrs. John C. Cooney and C. S. Hubbard, of the C. P. R. Telegraph Company, Ottawa, with a beautiful volume each in recognition of services rendered in the transmission of cable messages at the time of the critical illness of his son.

At a recent meeting of the Council of the town of Maisonneuve the electric railway question was brought up. Mr. J. L. Forget represented the Montreal Street Railway Co. and Mr. A. J. Corriveau, the Corriveau-Williams syndicate. Both companies submitted propositions which were referred to a special committee. The matter will be brought up again at the next meeting of the Council.

The St. Jean Baptiste Electric Light Co. held a meeting for the election of officers under the new charter, when the following gentlemen were appointed directors: Messrs. Arthur Caron, O. Marin, M.P., Hon. L. Tourville, Charles Chaput, O. Vanier, Joseph Girard, A. Lalonde, E. David and P. Terrault, M.P. At a subsequent meeting of the directors Mr. O. Marin, M.P., was elected president. The company have been supplying light for some time, and it is said have a monthly revenue of $1,000, with about $500 expenses.

A joint stock company, composed of Ottawa capitalists, has been formed to buy up and deal in mica and phosphate properties in the Ottawa valley. At the organization meeting about forty business men were present. The capital stock was placed at a quarter of a million dollars, of which $200,000 was at once taken up. It is the purpose of the company to purchase the mining interests of the district, open and work sufficiently to show the quality of the mines, and dispose of them. English syndicates are most likely to be the purchasers.

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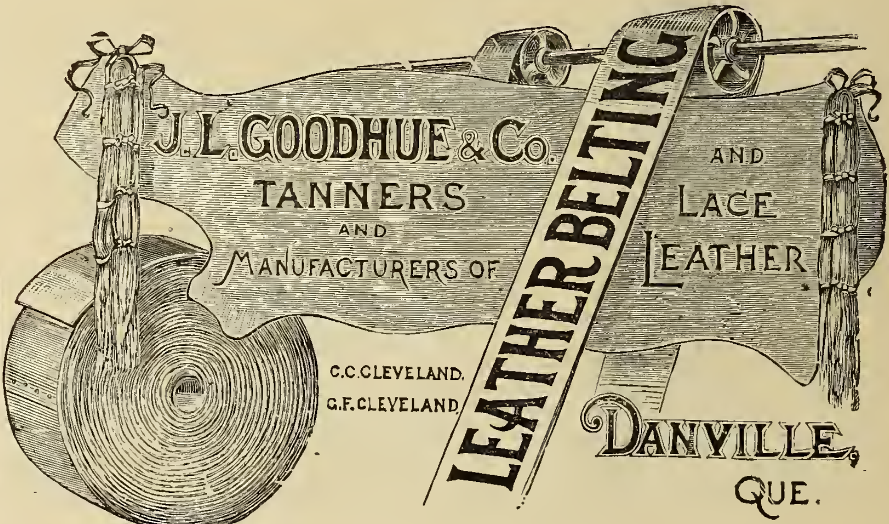

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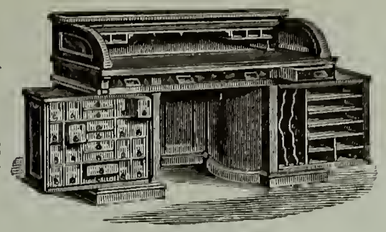

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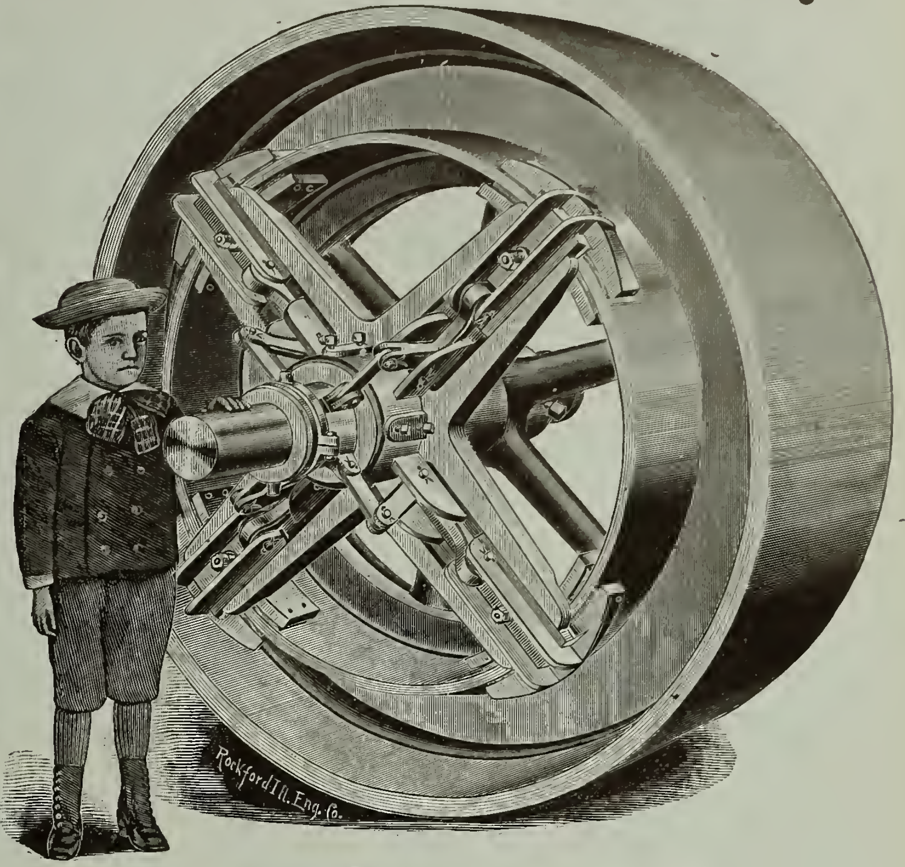
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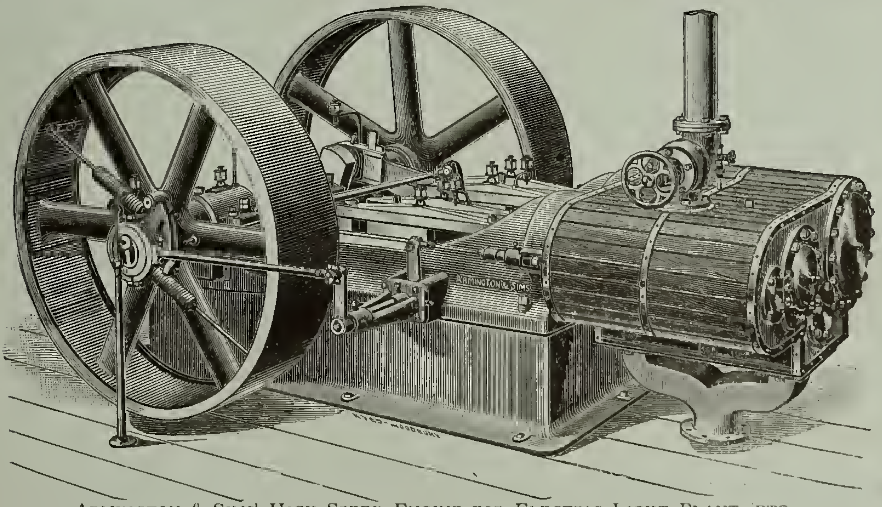

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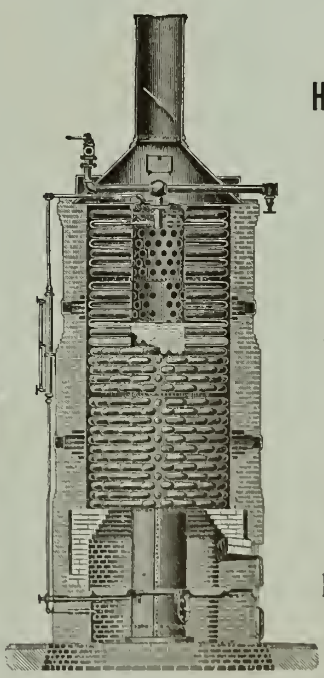

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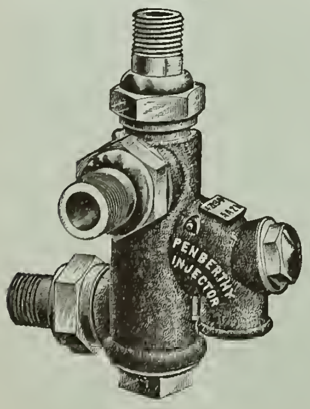

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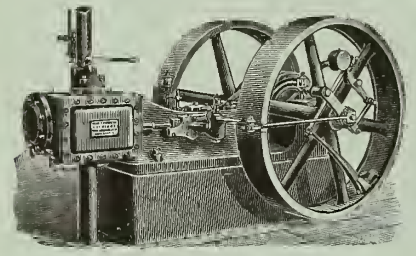

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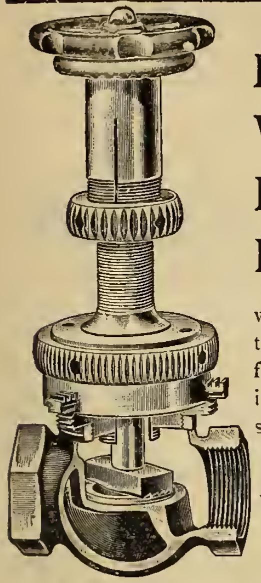

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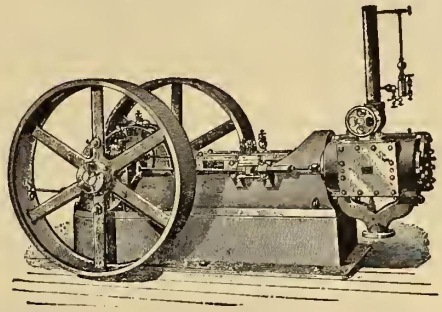

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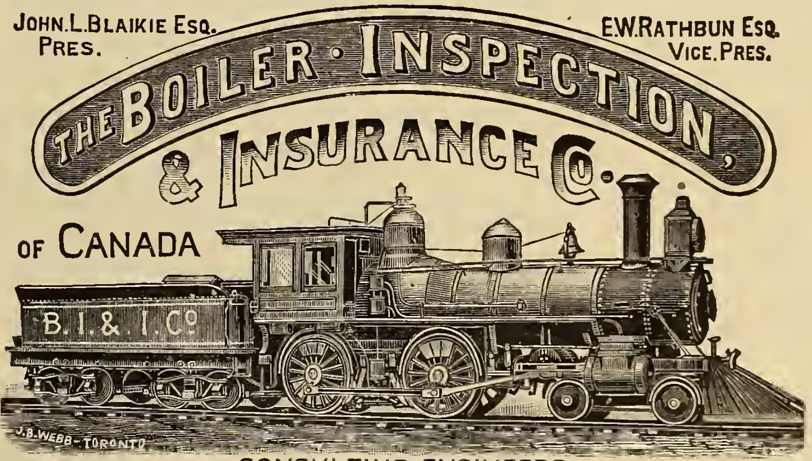

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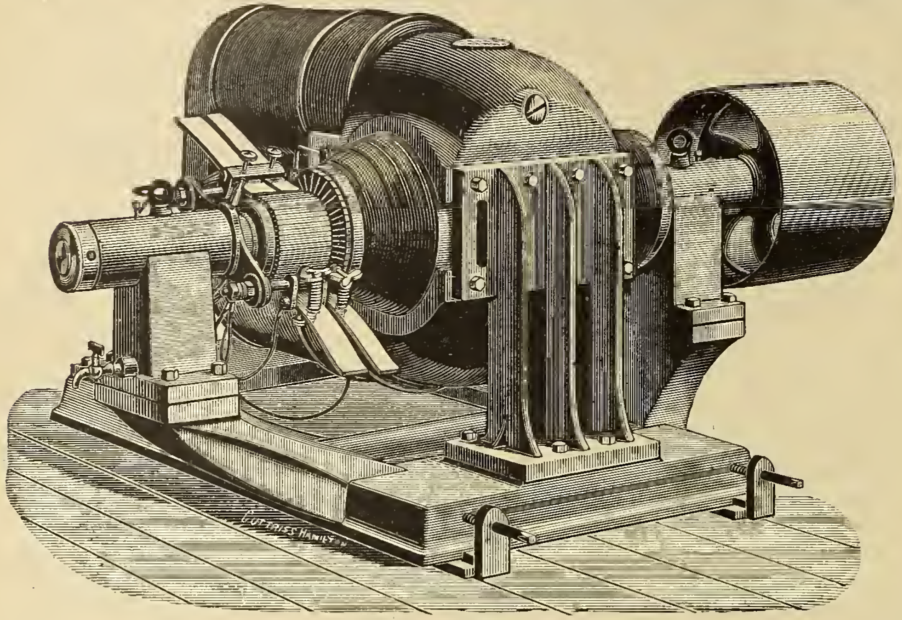

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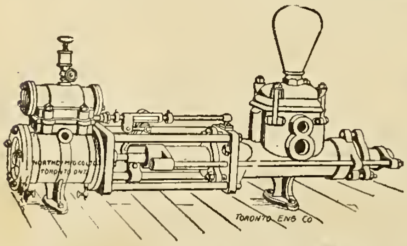

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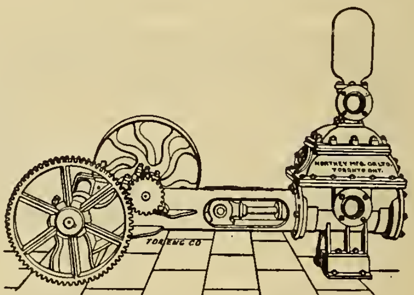

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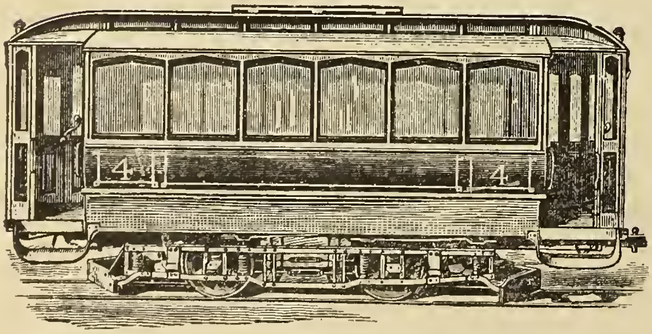

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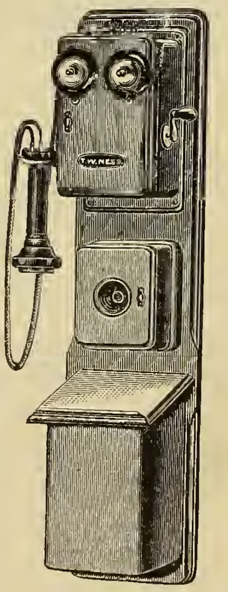

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STE. JULIE, Sept. 5th, 1892.

T. W. NESS, ESQ., Montreal.

DEAR SIR,—We are happy to state that your telephones and switches are giving us good satisfaction. We have three sorts of switches and we find yours far preferable. There is now about forty of your telephones in operation on our line. Every one works well, and we intend to use no other.

Yours very truly,
THE MEGANTIC TELEPHONE CO.

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T. W. NESS

Canadian Headquarters for Electrical Supplies

749 Craig Street, MONTREAL.

CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. III. JULY, 1893 NO. 7.

THE LATE JOHN A. WILLS.

IT becomes our painful duty to chronicle the unexpected death on the 16th of June, of Mr. John A. Wills, Chief Engineer at the Toronto Custom House. Mr. Wills, who was in his 48th year, was possessed of a naturally strong physical organization, and until the last two years enjoyed the best of health. Of late he was a sufferer from Bright's disease, and early last spring passed through a severe illness which several times threatened to have a fatal ending. Greatly to the comfort of his family and many friends, what seemed to be a marked improvement in his condition suddenly manifested itself two or three weeks ago; his appetite returned, he gained strength rapidly and was able to go down town. But a few hours previous to his death he drove around town with a friend who was on a visit to Toronto. After returning from the drive he lay down to sleep—which proved to be the sleep of death—for he passed quietly away a few hours later without having regained consciousness.

Mr. Wills was one of the best known and most popular men of the city, and his death came as a great surprise and grief to thousands of his fellow citizens.

The deceased was a native of Ottawa, in which locality his parents were among the first settlers. After graduating from college, he entered as an apprentice the machine shops of Messrs. E. & C. E. Gilbert, at Montreal, who at that time were the principal manufacturers in Canada of marine engines. On completing his apprenticeship he went to the New England States, where he spent several years, mostly at Fall River, Mass, where he met and married the estimable wife who survives him.

THE LATE JOHN A. WILLS.

He returned to Canada, and received the appointment of Chief Engineer of the Dominion Parliament Buildings, which position he held for three or four years, when at his own request he was transferred to Toronto and assumed the duties of the position which he occupied at the time of his death and for seventeen years previously.

He always showed a desire to assist his brother engineers. He was the first Registrar of the Ontario Association of Stationary Engineers, and in May last was elected to the Presidency. He was also a member of the Canadian Association of Stationary Engineers, and Chairman for the present year of the Technical School Board. He likewise filled prominent positions in connection with the Masonic order, the A. O. U. W., and the Orange Society.

His cheerful, sympathetic disposition made for him a multitude of friends, to whom his sudden death is the subject of profound regret. A wife, seven sons and one daughter mourn the loss of a beloved husband and father.

The National Electric Tramway Company, of Victoria, B. C., has purchased the business of the Victoria Electric Light Company of that city for the sum of $50,000. The plant purchased embraces dynamos, 30 miles of wire and 3,700 lamps. The purchasers intend to largely increase the capacity of the lighting plant, and to employ water power for the generation of current for both lighting and tramway purposes.

THE CANADIAN ELECTRICAL ASSOCIATION.

SEVERAL meetings of the Committee on Statistics have lately been held. A form of schedule has been drafted, which embraces enquries for statistics which would show the extent of the electrical industries of Canada, and the conditions under which they are being conducted. Copies of this schedule will be immediately forwarded to every firm in the electrical business in Canada, with a request that the blanks be filled in with the information sought to be obtained, and which if secured should prove to be very useful. The deputation which a few months ago visited Ottawa to oppose the bill for the inspection of electric lighting, greatly felt the need of statistics such as those which the Association is about to attempt to secure. It is hoped that persons engaged in any department of electrical business to whom copies of this schedule may be sent, will promptly supply the information required.

TORONTO ELECTRIC LIGHT CO.

THE Toronto Electric Light Co., in addition to having recently doubled the size and capacity of their central station, have erected handsome new business offices facing on Esplanade street, into the possession of which they have just entered. The new office building, which by the way was erected from the design and under the supervision of the versatile general manager, Mr. J. J. Wright, includes a commodious business office and an office for the manager on the ground floor, a large board room, and sleeping accommodation for officials of the company whose duties at times prevent them from reaching home. Of course the latest equipments in the way of electric bells, speaking tubes, etc., are employed. The office on the ground floor are handsomely finished in quartered oak, having stained glass windows, and comfortable looking fireplaces of pressed brick. We congratulate the company and the general manager upon these indications of progressiveness and prosperity.

PERSONAL.

Mr. John Bain, who for twelve years has been in the employ of the R. G. McLean Co., of Toronto, has been appointed to take charge of the water power station of the Niagara Falls Park and River Electric Railroad. Mr. R. G. McLean, on behalf of Messrs. R. G. McLean & Co., and of the employees of that firm, presented Mr. Bain before leaving for Niagara with a gold-headed cane and diamond pin, as a token of esteem. Mr. Bain is a member of the C. A. S. E., and is held in the highest respect by all his acquaintances, whose best wishes will go with him to his new position.

There are already a number of applicants in the field for the position made vacant by the recent death of Mr. John A. Wills. The salary is $1500 per year.

We have received from the Columbia Lamp Co., of St. Louis, a large size portrait framed in oak of Henry Goebel, who is claimed to be the original inventor of the incandescent lamp.

The Ottawa Electric Street Railway Company, at its annual meeting a few days ago decided to establish a car manufactory as a separate department, for which purpose a capital of $50,000 will be employed.

A QUESTION OF PRIORITY.

HAMILTON, June 15th, 1893.

Editor ELECTRICAL NEWS.

DEAR SIR,—In a recent article in the *Electrical Review* of New York, the writer, Mr. Allen R. Foote, claims to have been the "first in the field" in suggesting that an arc light be known by its amperage and voltage only, and not by candle power. Now, while we do not make any claim to priority in the matter at all, we beg to state that the contract made between this city and our company calls for lights of 10 amperes at 55 volts, and says nothing about candle power at all, and we have no doubt the same will be found to be the case in several other places where arc lights are being supplied on city contracts. We claim, then, that Mr. Foote's suggestion was nothing new under the sun in 1890, as our contract has now been running nigh on to four years.

Yours very truly,
THE HAMILTON ELECTRIC LIGHT & POWER CO.
D. Thomson, General Manager.

QUALITY OF ARC LIGHT CARBONS.

Editor CANADIAN ELECTRICAL NEWS.

SIR,—I note in a recent number of The *Electrical Review*, of New York, a short article on the "Development of Arc Light Carbons," in which the writer is made to say that, "A carbon manufacturer five years ago would make a poor showing if tested in comparison with one of the present day." I am in a position to say that just the opposite is the case. I had oppertunity not very long ago to see tested some Wallace diamond carbons (so called) that were manufactured away back in the early period of the electric lighting industry, and which burned better, lasted longer, were more evenly coated, and fully 50% better in efficiency than most of the carbons in use at the present day. True the price of them was about 10 cents a piece, but to say that they were of poor quality or not equal to those now manufactured is incorrect as any one who has had the handling of arc lights from the start to the present day can amply testify.

Yours truly,
CENTRAL STATION MANAGER.

MOONLIGHT SCHEDULE FOR JULY.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1......	P. M. 8.00	P. M. 10.40	2.40
2......	" 8.00	" 11 10	3.10
3.	" 8.00	" 11.30	3.30
4......	" 8 00	" 11.50	3.50
5......	" 8.00	A. M. 12.20	4.20
6......	" 8.00	" 12.50	4.50
7......	" 8.00	" 1.10	5.10
8	" 8.00	" 1.40	5.40
9......	" 8.00	" 2.20	6.20
10......	" 8.00	" 3.10	7.10
11......	" 8.00	" 3.40	7.40
12......	" 8.00	" 3.40	7.40
13......	" 8.00	" 3.40	7.40
14......	" 8.00	" 3.40	7.40
15......	" 8.30	" 3.40	7.10
16......	" 9.00	" 3.40	6.40
17......	" 9.20	" 3.50	6.30
18......	" 9.40	" 3.50	6.10
19......	" 10.00	" 3.50	5.50
20	" 10.20	" 3.50	5.30
21......	" 10.40	" 3.50	5.10
22......	" 11.00	" 3.50	4.50
23......	" 11.20	" 3.50	4.30
24......	" 11.50	....	4.00
25	....	" 3.50	
26.	A. M. 12.20	" 3.50	3.30
27......	" 1.20	" 3.50	2.30
28......	No light.	No light.	....
29......	No light.	No light.	....
30......	P. M. 7.50	P. M. 9.50	2.00
31......	" 7.50	" 10.00	2.10
		Total,	143.50

A company is said to have been formed for the purpose of cleaning and repairing incandescent lamps, the bulbs of which have become blackened and the filament impaired by use. The process, as described, consists of cutting a hole in the glass and by mechanical or chemical means cleaning the interior of the bulb, re-flashing the carbon, exhausting the bulb and resealing it.

THE ELECTRIC HEATER. †

By THOMAS AHEARN.

THE increasing interest manifested in electric heating apparatus during the past year throughout the United States and Canada is highly satisfactory and, without a full knowledge of what interesting application of heating devices may have been made in the United States, I will endeavor in this paper to outline what we have accomplished in Canada, and more particularly in the city of Ottawa.

The ideas relating to the limited field of electic heating are fast disappearing, and the notion that an electric light or railway plant, unless operated by water-power, cannot profitly introduce electric heat, is but an instance of history repeating itself, as witness the introduction of the telephone, incandescent light, etc.

When friction is overcome, heat is produced, whether the friction be the resistance of any portion of an electric circuit or of a purely mechanical character, as, for example, the application of the ordinary car brake; the resultant equivalent in each case appears as heat, so that if one or five horse-power of electrical energy be absorbed in an electric heater the full amount is converted into heat.

A mechanical example of this conservation of force may be demonstrated by rubbing the right hand on the coat sleeve of one's left arm. If the rubbing is brisk and continued, an unpleasant heating of the hand will result; the force expended in the muscular effort of rubbing results in an exact equivalent of heating of the hand, and the coat sleeve rubbed. This result is practically analagous to the heat developed in the heating wire of an electric heater. The resistance (or friction) offered, as in the rubbing of the coat sleeve, results in the developing an exact equivalent of heat.

The operation of the electric heater may also be compared to that of an incandescent lamp, in which, as is well known, good conductors of electricity are carried to the terminals of the lamp filament, and the latter purposely made a poor conductor, in order that the resistance offered by the filament and overcome by the current may produce a sufficiently high degree of heat to give the desired light. Although light alone is the object sought, it is but an accompaniment of the incandescence of the filament. In the electric heater, heat alone is desired, and heat alone is present.

The size and length of the lamp filament and wire of the heater are both determined in very much the same manner, excepting that in the case of the heater, the calculation for amount of wire does not subject the heater wire to such a degree of heat as in the case of the incandescent lamp. The size and length of wire employed in a serviceable electric heater should be such that the heat developed will not be sufficient to destroy it by oxidation of fusion. This is greatly assisted by the design and other conditions of manufacture, and in the case of my cylindrical 500 volt upright car stove, the inlet of cooler air at the bottom, and its rush through the heated cylinder, results in a vigorous circulation of the air through the space to be warmed, and this displacement of hot air by cooler air constantly relieves the heater wire within the stove.

Instead of making heaters on the plan of the rheostat, I have found that for marked results, and more particularly for the air draught, it is desirable to conserve the heat within the heater up to a certain degree, above which the construction of the heater should not permit the wire to reach.

I have also concluded that iron wire is most desirable, and among many of the points in its favor is that its resistance increases with the heat. The benefit of this quality is felt when the electromotive force is increased, as frequently happens for short intervals in nearly all classes of circuits.

By the method of construction and the use of good non-conductors of heat, as insulation and packing, the heat developed in small water heaters and large water furnaces is directed to the copper water-containing vessels around which the heating wire is wound; the heat is quickly transferred from the wire to the copper vessel, which can never reach a very high degree of heat. The air draught in my other heater operates in very much the same manner as the presence of the water in the liquid heater.

It is an interesting fact that the good conductors of heat are also the good conductors of electricity, and the poor for one is also poor for the other. This conductive quality, which is common to both forms of force, is very suggestive of a close relationship, which doubtless future investigation will determine. With the good conductors, such as copper, the current may be imagined as gliding freely through the atoms of the copper; while in the case of the comparatively poorer conductor—iron—the atoms may be pictured to throw themselves, like barriers, across the track of the current, this friction (or as we electrically term it, resistance) resulting in the development of heat. The mutual convertibility of the various natural forces is evinced from the combustion of coal in a power house, the dynamo converting the energy supplied by the coal into the convenient form of electricity, which is transmitted along wires to electric heaters placed at different points in the circuit, where we again have heat as at the starting point, the heater in turn giving up its heat to the surrounding air. It is evident thus, that from electricity heat may be obtained. It is also true that from heat we can obtain electricity as in the ordinary thermoelectric pile—the application of heat to the junction of the dissmilar metals of the pile will be demonstrated by the movement of the needle of the galvanometer.

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† Paper read before the Chicago Electric Club.

I will now proceed to a brief description of some of the electric heating installations which have been in successful operation during the past winter.

In July of last year I had erected in the car shop of our local electric railway a baker's oven eight feet square, which was built of brick in the usual way, excepting that within the oven, and set in the foundation, were placed two of my 20 ampere, 50 volt cylindrical stoves, the interior of the oven being whitened and lighted with incandescent lamps; a small window looking into the oven, and provided with three panes of plate glass, separated from each other by air spaces, being provided for the purpose of observing the process of baking, cooking, etc. The oven was also equipped with a clock and a pyrometer, which latter instrument recorded the degree of heat within the oven. The pyrometer indicating 400 degrees Fahrenheit, a neighboring baker tried a few pans of buns. The process of baking was watched with much interest, and from the puffing up of the dough to the pretty brown finish could be seen through the window of the oven which, as before stated, is provided with incandescent lamps. A short time after a full dinner of one of our leading hotels was cooked, including a 21 pound roast of beef, several turkeys, ducks, lamb, etc. This electric dinner was served to the regular guests of the hotel, together with a distinguished company of invited guests. The cooking of the meats was pronounced perfect, and the time occupied in cooking was 30 minutes less than is usually required to do the same work in the hotel range.

It may be interesting to state that this oven has been in full blast since it was started, and the current has been applied constantly night and day without trouble of any kind, and it is now used in drying out repaired electrical parts of railway equipments.

At the Central Canada Fair, held in this city in September of last year, a baker's oven the same as described was erected in the main building, attended by a staff of bakers. The oven was provided on one side, with a window, through which our delighted ruralists gazed in wonder. The oven proved the great card of the show, and the presence of a special policeman was required to keep the crowd moving. The baker started in selling a small bag of buns at five cents on the first day, but the law of demand justified him in increasing the price to 25 cents on the last day of the exhibition, when the supply was not sufficient although 14 pans were turned out every 14 minutes. In the same building the Women's Christian Temperance Union Dining Hall was made somewhat more attractive than in former years by the use of large electric water heaters, which supplied a dozen smaller heaters placed conveniently, and in which were made tea and coffee. The outfit was kept in continuous operation during the Fair, and although hard pressed by the crowds present, the supply was ample; no other means of heating water was employed. The success of this display will be best appreciated by the fact that the financial results were for the first time in many years of a satisfactory nature.

An ordinary hot water radiator connected with an electric furnace placed in a pit below the door, lighted by incandescent lamps and covered with an iron grating flush with the floor, attracted the attention of householders. The absence of a chimney and other accessories of a hot water coal furnace added to the fact that the closing of a switch only was necessary to obtain heat, which might be continued indefinitely without dirt, dust or labor, were doubtless the main reasons for the innumerable inquiries made as to the cost of operation, etc.

As no long continued test of this form of hot water house heating had ever been made, I concluded that only two installations of this description should be made during the winter just passed.

The first installation was made for the purpose of heating a gentleman's conservatory in this city. The furnace was placed in the basement, the controlling switches on the floor above, and all connected with the 50-volt lighting circuit. The total amount of pipe employed in the conservatory was 300 feet, the current absorbed being equal to three horse-power. The amount charged by the light company was based upon the cost of an equal amount of power from motor circuit. The operation of this plant has been a great success, having worked continuously and absolutely without attention since October last, the user being so much pleased with its success that the question of heating the entire premises electrically is now under consideration.

The second installation of the hot water system was made in R. A. McCormick's drug store, Sparks street, this city. The premises was piped throughout for hot water heating in November of last year, the electric furnace being placed in the basement. This 50 volt furnace was constructed in five independent heaters radially connected to a common supply pipe, each heater being independent of its neighbor, the five sections both mechanically and electrically being connected in multiple. Each of the sections was controlled by five 10 ampere switches, which were placed in a row in the store above, so that for all conditions of weather the heat could be regulated by turning off and on any of the five sections into which the furnace was divided. Another important consideration which suggested this design was that in the event of trouble with any one of the five sections comprising the complete furnace, it could be detached by closing the valves, and the particular section which might require examination could be removed without disturbing the other four-fifths. Despite the fact that the past winter was unusually severe in this usually cold climate, this outfit worked without a hitch and without attention of any kind, and provided at all times the heat desired.

For the usual Christmas display of the Chaudiere Electric Light Company, I designed an electric upright boiler which operated a one horse-power engine and the boiler being placed upon a large table in the company's office. The boiler was provided with steam gauge water glass, safety valve, etc. Being nickle plated throughout, it presented a very handsome appearance. The safety valve was set for 35 pounds pressure, which operated the engine. As heretofore steam engines have been employed in applying the power necessary to energize dynamos, the novelty of this outfit consisted in the fact that the electricity was developed by water power, which was converted into heat, making steam in the boiler, and which was then used in driving the steam engine.

The charge that is here made for current used in the numerous one gallon water heaters, which have been largely introduced by the Chaudiere Electric Light Company, is based upon the amount charged for the 16 candle-power lamp, which is $8 per annum (the user paying for lamp renewals). Motor rates are charged for larger installations. These water heaters are used in barber shops, drug stores, bar-rooms, etc., and absorb three times as much current as one 16 candle-power lamp—3 × 8 = $24. The company collects 50 cents per week for current supplied each heater, making $26 per annum, as against $24 if the same current was used for lighting. The charge is considered small by users, and the service is very satisfactory.

The business done during the past year in electric heating devices of various kinds has amounted to a very respectable sum, and will here, as it should elsewhere, increase from year to year.

The Merchants' Telephone Company has obtained unrestricted right of way in the city of Montreal. The Sherbrooke Telephone Association have made arrangements with the Merchants' Telephone Co., by which at an early date the subscribers to the Association will have communication by metallic circuit with Montreal.

THE TESTING OF DYNAMOS AND MOTORS.*

By Hazen Ritchie.

The first and probably the most important series of tests which are made on any machine are those from which the characteristic curves are obtained. The characteristic curves give us practically everything we require to know about a machine, and from them we obtain all necessary data for making any necessary alterations and improvements.

The most important curve to be taken is the curve of magnetization in which the vertical ordinates represent the electromotive force in the armature and the horizontal absissae the ampere turns flowing round the fields.

In this test the speed should be kept constant, as no accurate corrections for variations can be made. The fields must be separately excited, preferably from a storage battery, as this gives a practically constant electromotive force.

The first point on the curve is obtained by measuring the voltage at the brushes when the fields are open circuited, and which is due to residual magnetism. The fields are then excited, weakly at first, and readings taken of voltage, amperes in the field and speed.

The fields are gradually strengthened, readings being taken at each change, until a great change in the feeding current is required to produce a small change in the voltage ; great care being taken to keep the speed constant throughout.

To make this test of any value, only the most accurate instruments should be used. The best instruments for this purpose are a Thomson reflecting galvanometer combined with a high resistance of say 1 megohm or a condenser for measuring the electromotive force, and a Thomson quadrant electrometer shunted across a standard resistance of say 1 ohm, which is in circuit with the field, for measuring the current in the fields. Both these instruments should be calibrated with two or more standard cells checked against each other, both before and after the test.

The next tests in this series are the quarter, half and full load curves. These are taken in the same way, except that a quarter, half or full current is taken from the machine, the current being kept constant by means of an adjustable resistance.

Other curves which are of interest show the relation between the volts and amperes in the external circuit, the speed being kept constant, and the volts and amperes in the external circuit at various speeds.

The next test is the efficiency test. In generators this must be made in one of three ways : either by indicating the engine used for driving the machine and measuring the output ; by measuring the power supplied by means of a transmission dynamometer, or by coupling two machines of the same type, one as a motor and one as a generator, and dividing the loss equally between them. This is by far the most satisfactory method, all the readings being easily made ; and, in testing large machines, by coupling back to line we need only use the power lost in the inefficiency of the machines. That is, we could test two 100 h.p. machines having an efficiency of 85% with a generator capable of giving only 30 h. p. This saving of power would be a large item in factories constructing large machines.

This last method of obtaining the efficiency has the great advantage that we are able very accurately to separate the mechanical losses due to friction of the moving parts from the purely electrical losses.

In all these tests corrections have to made, when machines are not directly connected, for loss in belt or gearing.

There is some question as to the correctness of dividing the loss equally between the machine running as a motor and that running as a generator. Mr. W. M. Mordey, in a recent paper before the Institute of Electrical Engineers, said that this might be assumed to be correct, and as he was not contradicted I think we may consider it so.

The efficiency of a motor is obtained by measuring the electromotive force and current taken and the power given out ; the power being measured either by a transmission dynamometer or an absorption dynamometer or brake, the latter being the preferable way. One of the simplest and best transmission dynamometers is that designed by Profs. Ayrton and Perry. This consists of a pulley fixed to shaft, a loose pulley and a pulley connected by springs to a plate rigidly connected to the shaft. The engine belt runs on the fixed pulley and the machine belt on the spring pulley. The extension of these springs causes, by means of a link motion, a bright bead at the end of a long arm to move towards the centre.

The distance of the bead from the centre being a measure of the power transmitted, by having adjustable links the leverage, and therefore the range, of the dynamometer can be varied at will. They have also designed a coupling on this principle for use on direct connected machinery. In several forms of transmission dynamometers the tension of the belt is measured by means of jockey pulleys held in position by spring balances and weights, and from this the power can be calculated.

Transmission dynamometers are unsatisfactory owing to the difficulty of taking accurate readings, and in the case of measuring the deflection of the belt by the complicated nature of the calculations.

The absorption dynamometer is usually some form of the Prony brake, which consists of two brake blocks placed round the pulley of the machine to be tested, and held together by bolts and thumb screws. A lever is fastened to the upper block, one end of which is secured to a Salter's balance which is made fast to the floor, the other carrying a counter weight. The brake is adjusted when the machine is at rest with the blocks slack, the counter weight being moved till the balance reads zero. The machine is started and the thumbscrews tightened until the required balance is obtained, the Salter's balance being adjusted by a nut at the end of the lever to keep the lever level. The horse power absorbed is found from the formula

$$\mathrm{H\,P} = \frac{2\pi r n P}{33{,}000}$$

when r = horizontal distance in feet from centre of balance to centre of shaft.

n = the number of revolutions per minute.

P = the Salter's balance reading in pounds.

It is important to note that neither the diameter of the pulley, nor the pressure of the friction blocks on the pulley, nor the coefficient of friction enter into the formula for obtaining the horse power.

Every reading taken during any test should be recorded, whether it appears to be correct or not, as very often important results are obtained from figures which at first sight appear to be contradictory and due to errors of observation. With each test the complete detail of the machine should be fyled, showing the number of turns on the armature and fields, the size of the wire and the copper resistance of the various windings both before and after the test, when the machine is cold and at the end of the run ; together with the insulation resistance before and after the run, and the final rise of temperature.

PURELY VEGETABLE BOILER COMPOSITION.

Messrt. J. C. Taylor & Co. Ltd., Bristol, England, manufacturers of boiler compounds solely for thirty-five years, have lately brought out a special and invaluable invention, called "Liquid Anti Scale," which is at the present time meeting with introduction in Great Britain, Canada, the United States, France, Germany, India and Australia.

This compound is claimed to be invaluable to all users of steam power, being an article which is free from all chemical matter. It not only proves powerful in removing, but effective in preventing the accumulation of scale, without injuring the boiler, also acting as a preservative to the plates and fittings. The advantages to be derived from the use of a guaranteed article, which this is, recommended it to proprietors of locomotive, marine and stationary boilers. The company are represented in Canada by Mr. L. Fuge, London, Ontario.

QUESTIONS AND ANSWERS.

In answer to the enqury of "Subscriber," Chatham, in the Electrical News for June, the Toronto Radiator Mfg. Co., of Toronto, write that they are manufacturers of Kieley's patent standard steam trap, and will be pleased to send full particulars regarding the same to all enquirers.

The annual statement of the St. John, N. B., Gas and Electric Light Company shows a gratifying improvement in the financial position of the business as compared with former years. The income from all sources was $76,523, and the total expenses $55,205.

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*A paper read before the Montreal Electric Club.

DYNAMO ROOM TALKS.

By Foree Bain.

Let us take the little things first; success is usually reached through close attention to little things.

A voltmeter is an instrument for measuring the electromotive force or difference of potential between any two points in a circuit, just as the steam gauge measures the difference of potential or pressure between the inside and the outside of the boiler. Pressure is an element of power in electricity exactly as it is with steam; it is necessary, therefore, that we should know continuously and reliably the pressure of our dynamo plant as our steam boiler. The economic operation of an incandescent plant requires the pressure to be kept within at least two per cent. of the proper voltage. If the pressure is a few volts too low, the lamps are not efficient in producing light; if too high, the durability and life of the lamps are very much below the normal value. In an electric railway power station we should have a voltmeter always in circuit. In a properly designed plant of this kind the electric pressure at the station should rise proportionately as the load comes on, and we should be able at all times to know just how much this rise is. If it is not maintained at a constant degree with the proportionate increase of amperes to line, there is sure to follow serious consequences, such as the burning out of armatures in the motors. The voltage being low, more current is required by the armatures in the motors to do the work, and it is the current that overburdens the armatures. They heat and chafe in consequence, finally, and often quickly burn out.

There are a number of things that may happen to prevent this increase of voltage referred to. A stiff governor on the steam engine; low steam at the boiler; engine overloaded, with less than full dynamo capacity; slipping of a belt; series field coil of dynamo short circuited;—any one of these would cause trouble which you would not be able to detect without a good voltmeter.

An ammeter should be in circuit with every feeder and every main at the station. You cannot be too well informed on just what is going on in your circuit. Remember you are handling an agent which you cannot see, feel, hear or smell, and this is the only means of telling what you are doing.

Don't get ammeters or voltmeters for your plant until you are sure you know just what you want. There are instruments now on the market that are not any more reliable than the method used by an old farmer for weighing his pigs,—which was to balance a pig on a rail on one side and a stone on the other, and guess at the weight of the stone. I will describe the construction and peculiarities of the instruments you are familiar with, and then give you my idea of what you require.

In a plant where a number of instruments are to be used, it is not necessary to pay extravagant prices for instruments of great delicacy and theoretical precision; there are cheaper instruments which will answer every purpose. These instruments will indicate within one per cent., which is quite close enough, provided they may be depended on; and for this reason one fine, standard instrument—one voltmeter and one ammeter—should be kept for the purpose of checking and recalibrating those in regular use.

Do without an instrument rather than buy one which is unreliable and which does not possess the features described. There are a number of instruments in the market which depend upon the power of a coil to lift a heavy piece of iron and pointer against the varying force of gravity. These instruments are sluggish of action, so that small changes in the strength of the current or potential difference that is being measured is not instantly indicated. The needle and other moving portions being large and heavy, the moment of inertia is great, and this moving in a weak magnetic field, upon any change taking place in the current strength, the needle would simply oscillate over the scale. Many changes might take place in the current strength, the current or potential even remaining constant at each of its various values for a very decided time, before the needle had come to rest and allow any measurement to be taken. An instrument with the needle dancing around over the scale is not of much practical use. These solenoid instruments also indicate differently for the same values, depending upon whether the readings are taken on the rise or fall of potential or current.

Instruments employing permanent magnets are not reliable; the effect of each measurement varies the condition of the permanent magnet. A temper fracture, which is liable to exist undetected, causes the strength to be constantly changing and consequently variable readings for the same value of current. A spring is the most unreliable and inconstant of all mechanical devices. Temperature affects its value, it is easily misplaced, and its molecular structure is changed with every strain to which it is subjected.

Multiplying devices of all kinds should be abjured; they have no place in a properly constructed voltmeter or amperemeter. Select an instrument in which electro-magnets, or the action due to the currents flowing in diamagnetic conductors, are employed. The moving portion should be the very lightest weight possible, and there should be no complicated multiplying devices. The instrument should be tested to see that it is absolutely dead-beat. This is an important feature. A voltmeter should be wound with a wire having a very small heat coefficient, and it should be wound with a resistance having at least fifty times as many ohms as the highest number of volts on the scale. For instance, a 600 volt instrument should have a resistance of at least 30,000 ohms. An ammeter, on the contrary, should have as little resistance as possible.—*Electrical Industries.*

SPARKS.

The St. Charles Co., of Belleville, are reported to have orders for 140 electric cars, all of which are to be completed before the end of the year.

The Bell Telephone Company's exchange at Ancaster, Ont., was recently struck by lightning, All the wires were burned and considerable other damage done.

The Toronto Street Railway Company are about to erect a two-story brick motor house on the corner of Frederick and Esplanade streets, at a cost of $30,000.

The Goldie & McCulloch Co., of Galt, are placing in the new electric light station in Pembroke two new engines and boilers, with necessary shafting, pulleys, etc.

An action has been entered by Mr. Lacroix, Building Inspector of Montreal, against the Montreal Street Railway Company for erecting a power house without a permit.

Owing to increase of business and the consequent need of additional accommodation, the Royal Electric Co., of Montreal, Que., are said to be about to issue $250,000 worth of new stock.

Mr. J. A. Culverwell, formerly contract agent for the Edison General Electric Company, has been appointed general agent for the Automatic Telephone and Electric Company of Canada.

An examination of the water powers on the East River near Hopewell is being made by the New Glasgow, N. S., Electric Light Co. with a view of utilizing the same to drive its lighting and power plant.

The Stratford Gas Co. has under consideration the advisability of establishing a power circuit. In view of this the promotors of a street railway who have for some time possessed a charter, are talking of constructing an electric road.

The Coal Saving and Smoke Consuming Company, Ltd., with a capital of $50,000 is seeking incorporation at Montreal. The promoters are Chas. J. Arthur, Thos. H. Turton, Wm. Angus and Jas. B. Kerr, of Montreal, and Frederick Jones, of St. John, N. B.

The Merchants' Electric and General Service Company have elected the following officers:—Mr. G. A. Greene, president; Mr. John A. Goose, manager; and Senator A. W. Ogilvie, Messrs. S. H. Ewing, James Cooper, G. S. Brush, E. Hanson and S. Finley, directors.

The application of the Hamilton Radial Electric Railway Company for incorporation has been refused as the powers asked for are exceptional and cannot be granted to a street railway company. The directors of the company are considering the advisability of seeking incorporation as an ordinary railway.

The Northern Graphite Co., Ltd., are seeking incorporation. Their headquarters would be Montreal and the capital stock $95,000. The company is composed of John Fraser Torrance, Frank E. Caine, H. E. Stearns, D. T. Stearns, Wm. Starke and Geo. R. Starke, of Montreal, and James E. Caine, of Boston.

Courtland Bronson, of Hamilton, Ont., recently received a patent for an invention by which he claims he can make 20-year-old whiskey from raw whiskey by removing all impurities. He cools the whiskey to 70 degrees below zero and then passes an electric current through it. He has been supplied with money to carry on his experiments.

Mr. Charles F. Medbury has resigned his position of agent for the Montreal district of the Canadian General Electric Co. and accepted that of general sales agent for Messrs. Ahearn & Soper, of Ottawa, the Canadian agents of the Westinghouse Electric Co., of Pittsburgh. In this position he will look after the sales of Westinghouse apparatus throughout Canada. Mr. Medbury has had an extensive experience with the Thomson-Houston Electric Co. in the United States, as well as with the Canadian General Electric Co. in Canada, and is exceedingly well qualified for the position he is to fill.

CANADIAN
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AND
STEAM ENGINEERING JOURNAL

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ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 25th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 22nd day of the month.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free. for $1.00 per annum, 50 cents for six months. The price of subscription may be remitted by currency, in registered letter, or by postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters must be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union, $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. *When ordering change, always give the old as well as the new address.*

The Publisher should be notified of the failure of subscribers to receive their papers promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

THE "CANADIAN ELECTRICAL NEWS" HAS BEEN APPOINTED THE OFFICIAL PAPER OF THE CANADIAN ELECTRICAL ASSOCIATION.

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GUELPH BRANCH NO. 6.—Meets 1st and 3rd Wednesday each month at 7:30 p.m. J. A. Angell, President; C. Jorden, Secretary.

OTTAWA BRANCH, NO. 7.—Meets 2nd and 4th Tuesday, each month, in Labour Hall. J. H. Thompson, President; Wm. O'Brien, Secretary.

DRESDEN BRANCH NO. 8.—Meets every 2nd week in each month; Thos. Merrill, Secretary.

BERLIN BRANCH NO. 9.—Meets 2nd and 4th Saturday each month at 8 p. m. W. J. Rhodes, President; G. Steinmetz, Secretary, Berlin Ont.

KINGSTON, ASSOCIATION STATIONARY ENGINEERS.—Meets twice each month over No. 1 Fire Station. J. Devlin, President: W. Gilmour, P. O. Box 699, Secretary.

THE Chief Engineer of the Dominion canals states that tests of the applicability of electricity to the working of lock gates are being made at Beauharnois Canal, and should they prove satisfactory, electrical appliances will be adopted in connection with the Canadian canal at Sault Ste Marie, water power from the canal being used to generate the electricity. The result of the test at the Beauharnois canal will be known shortly, and will be looked for with much interest.

FALSE notions of economy still prevail to a very large extent, notwithstanding that vast improvements in business methods have come into vogue within recent years. These false notions, singular as it may appear, frequently exist side by side in manufacturing establishments with the most improved mechanical appliances, and not unfrequently serve to neutralize the benefits which would otherwise be derived from the employment of perfect mechanism. Of what use is it to buy the most perfect and economical engine at a high price and place in charge of it a man who has never got beyond his A B C's in engineering? No doubt his services can be got cheap, and on the surface there would appear to be a substantial saving in salary as compared with the amount which would be required to pay a skilled engineer. This apparent saving soon disappears, however, through the medium of the coal pile, repair bills and depreciation of plant. Often, too, the manufacturer of valuable money-saving devices is blamed because the result of their use in the hands of incompetent engineers is not what it would be under skilful management such as they were designed for. A great deal of loss and trouble results to the owners as well as the manufacturers of steam plant because, as a gentleman bluntly expressed it to the writer the other day, the practice so often prevails of placing a "mutton head" in charge of nicely adjusted mechanical apparatus.

THE recent decision in the U. S., sustaining what has become known as the Edison feeder patent, will without doubt cause considerable trouble to the different lighting and power companies doing business in that country provided it is pushed to a suit for injunction. Whether the General Electric Co. will push their claims in this direction remains to be seen; in the meantime there may arise another Goebel to dispute their right, and it would be well for all interested in this method of distribution, and particularly those who have been using it for a long time, to try and fix the time at which they commenced its use, and then refer to the patent records to see if this does not antedate the original patents. What effect this decision may have on this side of the line we are not in a position to say, nor can we say if a patent was ever issued or applied for in this country. We fail to see, however, how the company can prohibit the use of feeders, for most assuredly they could not begin to operate even a small part of the plant now distributing currents by means of feeders. They may impose a royalty, but to our mind the question with them resolves itself into one of policy, and we do not think they will adopt the stringent and arbitary conditions that they have thus far done in the lamp case. We note also that they have been allowed an injunction to prevent a street railway company from using a trolley, on claim of ownership of the foundation patent by right of purchase. It may be that their claim in this direction is a valid one, and presuming this to be the case, before they try to stop all who are using this method of collecting the current from the wires, they will act wisely if they at least grant the right to continue its use on the payment of a small royalty. How much better it would have been, and how much better off they would have been, had they pursued this course in the lamp case. We doubt if there would have been one of the many factories that they have closed by injunction that would not have willingly paid them a royalty on all the lamps they manufactured, and upheld reasonable prices throughout. This would have brought the lamp competition down to the "survival of the fittest". We should not be surprised to wake up some fine morning and find that somebody has injuncted somebody else for using a dynamo for any purpose whatever. Although this may be an overdrawn surmise, yet it may become a fact sooner or later if monoplies are allowed to flourish in our midst.

MUCH diversity of opinion exists as to the proper engine to employ for the operating of generators for street railway work, some preferring one type, others something quite different. But little argument should be necessary to convince the most skeptical that the cross connected slow or moderate speed is the ideal engine for this class of duty. The engine may be either horizontal or upright, and either high pressure on both sides or cross compound, or in the case of very large units, tandem or steeple compound on both sides. It should be compound only if there is sufficient water available for condensing purposes or if very high pressures can be carried; not otherwise, else when there is little or no load on there will be a steady drag of the low on the high pressure on account of the steam being cut off early in the stroke and the low pressure cylinder being unable to get sufficient to fill it. We have seen an engine of this kind, of high speed, show a vacuum of 15 to 20 lbs. in the low pressure cylinder when the engine was only doing about 25% of its rated capacity; this of course meant a considerable waste of coal. In this case it did not take long to unship the valve on the low pressure end and let the high pressure end do all the work. However, when the proper load was put on the engine, the valve was put back and the cylinder did good service with an initial pressure of 100 lbs. on the low pressure end. But to return to our subject, if those who contemplate using engines for street railway work will but remember that there are times when an engine being used for this purpose is suddenly required to jump from a few to hundreds of horse power in but a few seconds of time, and that this sudden load may come on at the very instant that the single side engine is on its centre, it may readily be seen why the second side with cranks connected to shaft at an angle of 90° with each other will help out and carry the sudden load without any appreciable effort, and with little or no fluctuation in the speed, particularly if the engine is provided with a good heavy wheel. We are aware that what are known as high speed engines will do the work perhaps equally as well, but they cannot be classed with low speed engines on the point of economy in steam consumption, not to speak of the expensive and frequent repairs required on them, which feature is almost entirely eliminated in the slow runners. Advocates of high speed engines claim as one of their points of superiority that with a number of units, should anything go wrong, one engine can be shut down and a spare one substituted for it for the time being, while with slow running engines if anything goes wrong it perhaps means the shutting down of the entire plant. But we think we are safe in saying that there is not one chance of such an engine breaking down to a dozen or twenty in the case of the smaller high speed engines, as any one who has had the running of the two kinds will know. While each style of engine has its admirers, we must enroll ourselves on the side of slow running cross connected engines for electrical work of all descriptions.

LEAD water pipes that are used on streets occupied by electric railways who use the rail for a ground and return, are found in various places to be seriously affected by the eating away of the outside of the pipe by electrolytic action. Electrical journals from time to time have recorded cases of this kind, some of the most recent being in the city of Hamilton, where the water department have been compelled to renew the service pipes in quite a few places, the worst affected seeming to be in close proximity to the power house. It would perhaps be quite a difficult matter to advance a proper theory for this result. It is perhaps caused by the pipe being laid in a particularly dry sandy soil, and by the return current in its effort to reach a good ground finding such ground by way of these lead pipes to the water mains in preference to forcing its way to a wet spot in the ground through dry sand or perhaps rock. That it should occur in the immediate vicinity of the power house is more difficult to account for, unless it be that the rail connections on the ground plate at that end offer a greater resistance to the passing of the current than does the intervening earth between the rails and these numerous water service pipes. In the case of Hamilton the water mains are several feet higher than the level of the bay and the streets all dip at a very great angle to the bay, forming thereby a water shed that must result in a somewhat dry sub-soil. That the pipes are eaten away as the result of the current going to ground through them there can be no doubt, and that this action is purely an oxidization of the metal through the electrolytic action is reasonably certain. To remedy the trouble we think will be quite a difficult matter, but as experiments in that direction will no doubt be the order of the day, we would suggest the following as worthy of consideration and trial: Wrap the pipe with a covering of tarred (pine tar) hemp about half an inch thick before burying it; give the outside of the pipe a thick coat (or two or three coats) of a good, hard, but elastic japan, which has been well dried in an oven; let the outside of the pipe be enamelled with an elastic enamel, the same as is now being used on the inside of some lead water pipes; surround the pipe by a square box some 3 or 4 inches in internal diameter, thereby allowing an air space as an insulator; last but not least, see that the rails are well grounded, bearing in mind the fact that a hole dug some 6 or 7 feet in the ground and a good sized piece of an old boiler stuck in with a number 4 galvanized iron connection to the rail is simply no ground at all in a sandy soil, and would not be much better in a pool of water. For the carrying of heavy currents such as are used in street railway work, a good ground should consist of at least 100 square feet of exposed metallic surface, preferably copper, covered on its two sides with at least one foot in thickness of fine gas coke and buried in decidedly moist earth, and connected to each rail by a No. 0000 copper wire well rivetted and sweated on. With such a ground every quarter of a mile, and good and sufficient bonds between the rails we predict that the eating away of lead water pipes would soon be a thing of the past.

THE Canadian Electrical Association has missed the only chance it has had since its inception to make its name immortal. This chance came when a motion was made at the first convention of the Association in the City of Hamilton in June, 1892, to establish a standard for the nominal candle power of arc lights, which motion was voted down, principally because the subject was considered too grave a one for the Association to grapple with. Time now proves the fallacy of this reasoning. Our readers will have noticed in the electrical journals of the United States that one of the many subjects that will be brought before the Electrical Congress to be held in Chicago will be one to establish a standard of current or watts for the different nominal candle powers as used at the present time in speaking of or contracting for arc lighting. From present appearances it seems as though one of the methods which will likely be proposed will be to standardize the different arcs as of so many watts capacity, and to drop the candle power appellation entirely. Doubtless this is a step in the right direction, and will solve the problem to all intents and purposes, but we do not see why they do not adopt a standard for the several sized arc lights and let the voltage take care of itself, which it undoubtedly will do. We are decidedly of the same opinion as the mover of the resolution in the convention (Mr. D. Thomson), that with the proper carbons and lamps producing a quiet, steady, non-fluttering, non-frying and non-flaming arc, with a fixed current, they will take the same voltage in every case; consequently a watt standard is not what is required, but a current standard only. We commend this to the consideration of the members of the Congress to be held very shortly in connection with the World's Fair in Chicago. At the same time we wish to record the fact that the Canadian Electrical Association was the first society in America—and for aught we know, in the world—to have the matter brought up for consideration. That some action was not taken which would have placed it on record as perhaps the first mover in this important matter is, to say the least, a deplorable mistake. Questions presented themselves to the minds of some of the members that were entirely reasonable and rational from their standpoint, but that, nevertheless, should have had little weight in deciding so momentous a question. One of the objections urged was that as the Canadian Government was about taking some action with that end in view, their standard, if established, and that of the Association would conflict. What argument could have been weaker? What would have prevented the Government from adopting the Association standard? We doubt if they could have improved upon it. Another objection urged was that such a standardization would create discord between cities and towns which were buying their lights from private companies, from the fact that some municipalities would insist that they be supplied arc lights of the candle power and current called for by the Association standard. It seems a useless waste of words to say that there could have been nothing so easy of adjustment. It would have been an easy matter to convince such towns and cities that at the time their contract was made, the lights they were then furnished were known as of a certain candle power, and that any new standard established could have no bearing towards annulling their contract or in compelling the company supplying the light to live up to the new standard. Of course when it came to making a new contract with the company, if the Association standard was called for, it would in very many cases entail but a small expenditure to have the dynamos re-wound for the new conditions. Nothing now remains for the Association but to await the decision of the Electrical Congress and follow in its wake. If they adopt a standard, and it seems reasonably sure that they will, the same hardships will be experienced by would-be suppliers of a 2000 c.p. arc light with 7½ amperes of current as would have been had the Association instead of the Congress adopted the standard, for be it understood that this standard will be used in Canada to as great an extent as would have been the one adopted by the C. E. A. That there should be some sort of a standard is unquestionably a fact, for at present we know of from 4 to 5½ ampere lights being called 1000 c.p., of 5 to 6½ being called 1200 c.p., and of from 7½ to 10 amperes being called 2000 c.p. This is very misleading to those whose knowledge of such things is limited. That the C. E. A. will profit in future by the lesson they are now about to learn we sincerely hope.

IT is understood to be the intention of the Canadian Association of Stationary Engineers to make an exhibit of models and inventions in the line of mechanical engineering, at the forthcoming Montreal Exhibition, which will be held simultaneously with the Convention of the Association.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of the various Associations are requested to forward us matter for publication in this Department not later than the 20th of each month.

RESOLUTION OF CONDOLENCE.

At the last regular meeting of Toronto No. 1, the following resolution was adopted: Whereas, it has pleased our all wise Creator and Heavenly Father to remove from this earth our esteemed friend and worthy brother engineer, John A. Wills, therefore be it resolved, that while we bow in humble submission to the Divine will of our Heavenly Father, we do at the same time extend our sincere and heartfelt sympathy to the bereaved family in this their hour of sorrow, and we deplore the loss of so eminent an engineer. Be it further resolved, that a copy of these resolutions be sent to the sorrowing family, be spread on the records of this Association, and also that a copy be sent to the mechanical press for publication. And be it further resolved that our charter be draped fnr the space of three months.

On behalf of Toronto No. 1, C. A. S. E.

A. E. EDKINS,
W. BUTLER,
GEO. GILCHRIST.

Toronto No. 1, C. A. S. E., elected officers at last meeting for the ensuing year, as follows: President, Wilson Phillips; Vice President, W. Butler; Recording Secretary, Herbert Terry; Financial Secretary, Geo. Mooring; Treasurer, A. M. Wickens; Conductor, S. Thomson; Door Keeper, J. Thomson; Trustees, W. G. Blackgrove, Charles Heal, Wilson Phillips.

Toronto No. 1, C. A. S. E., have appointed a committee of five to devise some means of bringing the aims and objects of the Association to the notice of the manufacturers and to invite their co-operation.

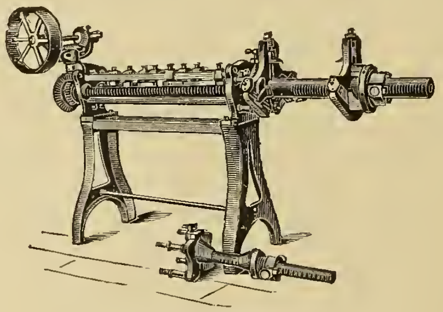
At the annual meeting of the Canadian Association of Stationary Engineers, held in Hamilton on June 11th, the following officers were elected:—President, W. Sweet (re-elected); vice-president, E. Johnson; recording secretary, William Norris; financial secretary, A. Nash; assistant permanent secretary, George Mackie; treasurer, W. Nash.

THE membership of Hamilton No. 2 numbers about 50, and the finances are in a flourishing condition. The Association is about to purchase an indicator for the use of the members.

THE ERIE KEY SEATING MACHINE.

The accompanying engraving represents the Erie Key Seating Machine, manufactured by the Burton Machine Co., of Erie, Pa. They are furnished with two or three arbors, as desired, to cut any width of key seat up to 2½″ wide. If the work is heavy and too large to be placed on machine it can be readily detached from stand and used as a portable machine, and fully meets all the requirements of a machine shop.

The arbors are made of steel and supplied with eccentric taper bushings to accommodate all bores within their range. Each arbor is hollow and has within a steel guide bar, movable up and down by means of a screw at each end. It is planed through its entire length the necessary size and shape to carry within a tool bar. This steel tool bar carries two tools of the width desired for the key-seat. It is connected to the driving carriage by means of a removable pin, and is driven back and forth through the guide bar, cutting in both directions, and fed down the desired depth and tapers by the screws at the ends.


THE ERIE KEY SEATING MACHINE.

The driving apparatus consists of two parallel screws 2½ inches in diameter, ½ inch pitch threads. They are set six inches from center to center, and run in opposite directions; between them is an open-sided nut which slides from one to another within a carriage. The nut engages in one screw and travels the desired distance when it comes in contact with a cam which throws it out of gear, and by a spring it is pushed in gear with the other screw. The nut has on its top two ribs, one of which, by passing behind a guide, holds it in gear. The other serves to receive the pressure of the spring. By shifting the cams and springs, any desired length of stroke can be made. The travelling of the nut carries with it a carriage to which the cutting bar is attached. The screws are driven by cut gears running smoothly and giving a very strong motion to the cutter bar.

With an attachment for the purpose, seats can be cut in holes as small as 1 inch in diameter by one passage of the cutter.

Mr, John A. Burns, B. A. Sc., machanical engineer and manufacturers' agent, 686 Craig street, Montreal, has the sole agency for these machines in Canada.

TRADE NOTES.

Messrs. Patterson & Corbin, of St. Catharines, have been given the order for the cars required for the proposed electric street railway at Kingston.

The Waterous Engine Works Co., of Brantford, are just starting at Windsor for the Sandwich and Amherstburg railway, an addition to their plant, consisting of 43 feet of 5½″ steel shafting, 9 heavy floor stands with extra strong ring oiling ball and socket pillow blocks; one solid pulley 45 × 24″ face, and the following grip pulleys: 54 × 16, 84 × 12, 86 × 12, 54 × 22, 53 × 17; one 350 combined friction grip pulley 72 × 10½ face and grip coupling; two 300 h.p. grip couplings; one heavy tightener frame with screw adjusting for a 36 × 24½ pulley. They have also an order to ship next month for the Wingham Electric Light plant 5 pairs of grip gears connecting a shaft 84 feet long with 5 water wheels, with its ring oiling ball and socket boxes and floor stands and several grip pulleys.

SPARKS.

Mica deposits have been found in Burgess and Bastard townships, Leeds county, Ont.

W. C. Green has been offered a large sum of money for a mica mine near Arden Station.

The Arnprior Electric Light Co. will probably install a new engine next fall with which to operate their plant.

The Merchants' Telephone Company is about to commence operations in Montreal, and will advertise for poles.

Michael Keegan has been registered proprietor of the Keegan, Milne Co., manufacturers of electrical supplies, Montreal.

The Montreal Street Railway Company are erecting iron posts on Notre Dame, Windsor, Peel and other streets in Montreal.

The Kingston Electric Light and Power Co. will enlarge their lighting station and will put in two new boilers and a new engine.

The corporation of the town of Port Arthur intend applying to the Legislature for power to enable them to do street and commercial lighting.

The Kay Electrical Works, of Hamilton, have applied for a patent for a combined motor and dynamo which will furnish both light and power.

Tenders have recently been invited for the purchase of the Vancouver Electric Railway and Lighting Company, which is in the hands of a receiver.

The St. Henri Light and Power Company will apply for power to increase their capital stock to $1,000,000, and make other amendments to their charter.

The Thomson Electric Welding Co., of West Lynn, Mass., has nearly completed an electric loom. This will be the introduction of electricity into another branch of industry.

Mr. A. W. Congdon, formerly engineering representative of the Canadian General Electric Co for the Montreal district, has been appointed agent of the company for that district.

The town of Arnprior has granted for a term of twenty years to the Automatic Telephone and Electric Company, the privilege of erecting wires and poles on the streets of the town.

The citizens of Toronto Junction are talking of requesting Mr. A. Campbell to install in his new flour mill, a dynamo sufficiently large to supply electric light for commercial purposes.

In view of the intention of the Government to widen the approaches to the Ottawa bridge on the Hull side of the river, the Ottawa Electric Railway Company has decided not to enter at present into any agreement to establish an electric street railway in Hull.

A telephone line is to be constructed from Revelstoke to Kalso and Nelson, the centre of the Kootenay mining district, British Columbia.

The Toronto and Scarboro' Electric Railway Company propose to issue bonds covered by a mortage on the present and future assets of the company, for the prosecution of its undertakings.

There appears to be a greater demand for mica than any other material at present. Mr. James Stark, a dealer in minerals, has just returned from England and intends shipping 100 tons in a few days, and will continue to send large shipments until fall.

Messrs. E. Leonard & Sons, of London, engine and boiler manufacturers, have opened an office at 79 Bay street, Toronto, and have placed in charge Mr. Thos. Nopper, who has been in their employ for the past twelve years.

The county council of Welland has granted to Messrs. Dawson & Syme power to construct a street railway between St. Catharines and Port Dalhousie, and will request the Minister of Railways and Canals to give them permission to cross the canal bridge.

The town council of Toronto Junction has decided that the town shall retain its own electric light plant. As the law will not allow corporations to do commercial lighting, the merchants are anxious to see how the council will deal with this phase of the question.

At the annual meeting of the electric light company of Amherst, N. S., the Board of Directors was re-elected. No dividend was declared, but though the business of the past has not fulfilled the expectations of the shareholders, the prospects for the future are brighter.

The following gentlemen have been re-elected the Board of Directors of the Chaudiere Electric Light and Power Company, of Ottawa: T. Ahearn, G. P. Brophy, J. W. McRae, Thos. Workman, W. Y. Soper, R. Hurdman, W. G. Hurdman, Wm. Scott and Wm. Hutchison.

Messrs. W. H. Wrighton, H. Long and M. T. Ostrum, merchants, of Peterboro', Ont., are seeking by an injunction to restrain the construction of the proposed electric street railway on the business portion of George street. The road has been completed almost up to the point mentioned.

The Montreal Park and Island Railway Co., consisting of Sir Donald A. Smith, Hon. Louis Beaubier, Messrs. R. L. Gault, David Morrice, M. Perrault, D. Graham, Senator Thibeaudeau, and a number of New York capitalists, has been consolidated with the Corriveau-Williams Street Railway Co. and has taken over all the franchises held by the latter company.

An act of incorporation has been obtained by Alex. Fraser, Westmeath; Wm. Gibson, M. P., and Richard Fuller, of Hamilton; John Mather, of Ottawa, and W. H. Brouse, of Toronto, unber the name of the Keewatin Power Co., to furnish hydraulic and electric power from the Winnipeg river, and to establish factories, dwellings, etc. The capital stock is $1,000,000.

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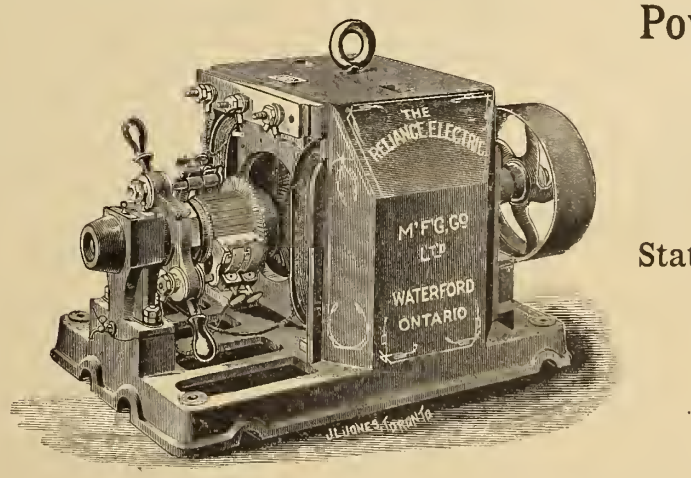

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ELECTRIC INSTALLATIONS AND SOME RADICAL CHANGES IN GENERAL SYSTEMS OF WIRING.*

By Charles G. Armstrong.

It is not my intention this evening to enter into a general discussion of isolated electric installations but simply to point out common errors and suggest such remedies as would seem, in my judgment, to make a better plant. In planning a building it is true that the designing of the electric plant is generally left until the last. In my experience I have found it not an unusual thing to be called upon to design a plant, when upon receiving the plans I find that the architect has left room for the plumbers' pipes, has prepared excellent runways for drainage, has looked after his catch basins, has located his elevator pumps and given them plenty of room in the basement, has provided ample space for everything except the electric light plant. There are no raceways in the building, the space left for the dynamos and engines is totally inadequate, the boiler capacity is about half what it ought to be, no place for storage of coal, and yet the most important feature of the entire building is light. It becomes necess ry, of course, to at once make a claim for more space and provide raceways or some substitute therefor. Having obtained all the space possible the next item that confronts the designing engineer is how to lay out his plant.

There is a plant on State street that it was my duty to inspect and report upon a little while ago where I found an arc and incandescent dynamo running in a separate room about 50 feet from the switch-board. The plant really consisted of two separate plants connected to one switch-board ; the only redeeming feature about it was that there was only about an hour a day when both dynamos were running at the same time. This plant showed an insulation resistance of ten ohms to ground on the arc circuit and one-twentieth of an ohm on the incandescent circuit.

In order that the proprietor and others casually inspecting the plant would have a good opinion of it, the highly ingenious electrician in charge had disconnected the ground wire so his plant always showed clear on the ground lamp. It is often very much easier to remove the evidence of a ground than to go to the trouble of removing the ground itself. It would undoubtedly be better to have electricians of less ingenuity and more honesty in cases of this kind.

One cause of a bad plant is lack of forethought on the part of the designer of the building, another is desire to diminish the first cost, and a third is often force of circumstances. A person may have an old building, and to put in an electric plant he may have to accept what he finds and make the best of it. For the first two faults there is no excuse, and even the latter can be remedied by a little study on the subject and a proper selection of dynamos and engines. There is a great need to-day of a small unit direct connected slow-speed dynamo to be used in such places as I have last mentioned, where plants are to be installed in old buildings and the space is very limited. Perhaps some of you will say, "if you specify such dynamos, I will furnish them," but from the fact that it would require from six months to a year to design and perfect these sizes I would not dare specify them.

Generally when a man has concluded to put in an electric plant he wants it as soon as he can get it, and although he takes six months or a year to make up his mind, he wants the plant put in at once. But if such dynamos were constructed and kept in stock as ordinary dynamos are, I have no doubt that you would find a good demand for them and they would be a matter of great convenience both to the designer and the owner of the plant.

I prefer to get dynamos as close together as possible. The only conditions to be considered are first, that they will not be reversed in polarity by proximity of like poles, and second, that the armature of any machine can be removed without disturbing the other. A modification of this condition could be made where space is very limited by running the smaller machines in tandem, but as a general rule I do not favor this arrangement.

On the matter of foundations for dynamos I hold decided views. I like to have a good foundation under the dynamos, and while this is not as absolutely essential as a good foundation under the engines, yet a concrete or brick foundation in which the best quality of Portland cement has been used is a very desirable thing. A strong wooden frame should be bolted to this foundation, and the bed plate of the dynamo would be bolted to the wooden frame. The wood should be previously soaked and thoroughly painted with insulating and water proof compound. This insulates the machines from ground. Some companies insist that their particular type of machine needs no foundation. I have handled almost every machine on the market and I have yet to find one that runs as well without a good foundation as it does with one.

Switch-boards are the next item of importance. The switch-board should be placed within six or eight feet of the commutator of the dynamo or as near that as possible; a greater distance is unnecessary and a closer proximity is not desirable. I believe that switch-boards should be made of marbleized slate or marble. I prefer marble and I use white marble in many cases, but between white and Tennessee marble, I prefer Tennessee from the fact that it is less easily strained. Slate is somewhat cheaper than marble, but it absorbs moisture, which is a thing to avoid in switch-boards. If marbleized slate is used it should be thoroughly painted on the back to prevent absorption. There is one precaution which should be taken, however, in all marble switchboards, that is in fastening instruments thereto. From the unyielding properties of either marble or slate it is advantageous to have a coil spring, and connections should be made after the manner shown in Fig. 1, otherwise the instruments will soon become loose by the jarring of the board. In no case should the wire connections to the instruments be so placed that it can jar loose, as there is great danger of arcing.

Where more than one dynamo are used, bus bars, I believe, are better than any other method of connection. If they are placed on the front of the board they must be polished and lacquered, and if fine effects are desired, they can be nickel plated. If placed on the back of the board, rough and unpolished copper bars can be used. Bus bars shou'd be large, and of such capacity as not to heat perceptibly on the heaviest load. The object of this is to get a good connection. If they are made sufficiently large, connections can be tapped and screwed into them just as a bolt would screw into a nut. Where connections are made on the front of the board this method is not as desirable as the "stirrup," which is used pretty generally by first-class construction companies.

It should be the object of all designers of switch-boards to make the board as simple as possible. To avoid complications and yet have the board accomplish the purpose designed requires no little ingenuity on the part of the designer.

Electrical engineers and Philadelphia lawyers usually are not employed by owners to run plants. The salaries paid are so ridiculously small that in some cases the dynamo tenders are anything but what they should be in education or knowledge of the business. Often the engineer of the plant must also take care of the dynamos, although he admits that he knows nothing about them. The whole matter is a mystery to him except that he knows he must keep the brushes trimmed and perhaps polish off the commutator once in a while, and in order to perform his duty thoroughly he may perhaps use a file to do the polishing.

The great objection to connections being made on the rear of the board with bus bars, I find, is the liability of a great multiplicity of wires being run helter skelter across the back of the board, making the simplicity on the face of the board more than compensated for by the intricate connections on the back.

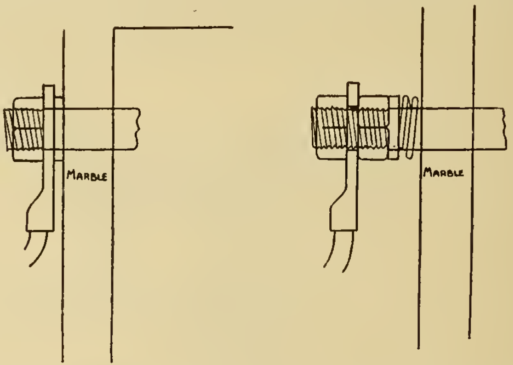

Fig. 1.

It often happens in very large buildings that the motor load amounts to quite a considerable part of the entire load. When such cases arise I believe in having a third bus bar on the board, which shall be used for motor connections. This applies only, of course, to such plants as have two or more dynamos. Where motor connections are used it is desirable to have an ampere meter to measure the amount of current used on the motors. This ampere meter should be "dead beat," and should have a range equal to all the motors in the installation. A careful attendant would know if his motors got into trouble or blow a fuse, and could also tell how the different loads were being handled throughout the building. This applies especially to cases where electric elevators are being operated from the same plant as the lights. As to other meters on this board I would prefer the non-polarized type, from the fact that they are less liable to get out of calibration. There is one slight disadvantage, perhaps, and that is if a machine should get to running as a motor an attendant might not as quickly understand it ; but it is seldom, indeed, that it occurs, and where it does the operator ought to know that the belt is pulling the wrong way.

Dynamo switches should be made double throw, one connection being onto the bus bars in such a manner that any or all dynamos can be thrown on the motor circuit. By closing a switch the motor circuit is placed in multiple with the lighting circuit. By opening this switch and throwing down a dynamo switch any dynamo is connected to the motor circuit.

Recently I was called upon to solve a problem in connection with the Schiller theater in this city, where the owners expected to take current from the Chicago Edison company's mains. As you are well aware the rules of the Edison company prevent the operation of 110 volt motors upon their lines from the liability of throwing their lines out of balance. They require that motors operating on their lines should be 220 volts. We were not using the three wire system in the building, and it was necessary to construct a switch-board in such a way that 220 volts could be obtained on the motor circuit from our own plant as well as from the mains of the Chicago Edison company. In order to accomplish this the dynamo switches are arranged to throw any dynamo in series with the others by a simple movement of the switch. The motors throughout the building are used to operate ventilating fans, and therefore can be operated at 220 volts or 110 volts according to the amount of ventilation desired. In addition to this a small rheostat placed in the field of each motor allows us to get any variation of speed desired with scarcely any waste of current. I may say in this connection that the use of ventilating fans is becoming more and more appreciated by architects and owners, and this method of varying speed is a very advantageous and economical way of regulating ventilation. In this point the switch-board is placed in the middle of the room, completely boxed, is very close to the commutator, and is convenient in operation.*

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* Read before the Chicago Electric Club, Feb. 20th, 1893.

There is nothing more important in an installation, outside of dynamos, than wire. Use always the best wire. In making tests upon wire I do not believe in soaking it in chloroform, naphtha, sweet spirits of nitre, or any other absurd method. In the ordinary course of events wire is not subject to the influence of any of the substances named. The greatest enemy of wire is ammonia; an enemy which is most potent, and which is found in any and all plastering; it is an incidental product in the settling of mortar, which is more especially found in patent plastering.

One of the greatest outrages perpetrated on electric wires is the use by painters of an acid wash to neutralize the acid in the plaster. This wash is composed chiefly of sulphate of iron and sulphuric acid; it quickly penetrates the plastering, and by its action on the nitrates contained therein evolves ammonia, which attacks and honeycombs the rubber insulation of the wire.

Within the last few weeks it has become necessary to remove all of the wire in a large building in this city, owing to just such barbarous treatment as that described. The only protection against ammonia that I know of is a waxy covering which is used on the best grades of weather-proof wire. I generally specify wire which is covered with a braid saturated with some compound to strengthen and protect it. Other enemies of wire are rats and mice and roaches. My experience has been that the weather-proof compound already mentioned will prevent them eating the wire; they are fond of rubber, but do not like wax. In addition to its chemical properties wire should have the ability to stand rough usage and bending without perceptibly breaking its insulation.

The present method of running distributing wires in fire proof buildings is, first, placing directly beneath the plasting with cleats; second, enclosing in interior conduit tubes; third, and most desirable, is running wires from cut-out cabinets in moulding to the rooms, and then under the plastering in interior conduit tubes to the outlets. This last method I have adopted almost exclusively. Fig. 2 shows one form of corridor moulding which I use. It has three compartments, one for each polarity of the light wires, and one for the bell wires. When leaving this moulding interior conduits carry the wires to the outlets. This is a better method than all interior conduits, as architects are every day limiting the thickness of plastering. Originally 1¼ inches of plastering was considered about right, now ½ inch is considered too much; in fact, many architects complain bitterly when asked to use enough plastering to cover ¼ inch tubing; but the greatest objection to running interior conduits clear back to the cut-out cabinets is that a large number of tubes are brought to one point and it is almost impossible to make the plastering adhere to them.

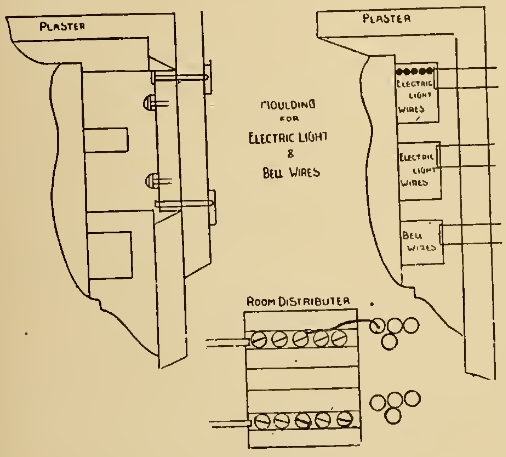

FIG. 2.

Many architects think that interior conduits should only be placed in the flooring. I object to this, because it is almost impossible to lay tubing in the flooring and to prevent them from being broken to pieces by the workmen. Theoretically it is a perfect way of wiring, practically it is anything but satisfactory in my estimation. I object to the indiscriminate use of interior conduit from the fact that a slight settling of the building will break and destroy the tubes in such a manner as to make them useless for the purpose for which they are intended. I do not wish to be understood as being opposed to interior conduit, as in 95 per cent. of my work I use it; but I believe in restricting its use to its proper place—using it in short runs between outlets, and then having some form of moulding to carry the wire back to the cut off cabinets. In office and hotel buildings this is especially applicable. The amount of conduit is reduced to a minimum and the liability of breakage from settling of the building is reduced in proportion.

For convenience of testing, I prefer an individual distributer, which consists of a horse shoe cut-out, having no fuses. This can be placed in the centre electrolier of the room from which a circuit will run to the outlets, or, where possible to do so, I use a block, which is placed in the moulding at the entrance to the room. All wires are run from the block to the outlets. In case of a ground in any line in this room, it requires but a moment to uncover this box and discover the line which is grounded.

All work described so far is in strict accordance with the rules of general wiring as pronounced by good authorities up to date. I wish now to disgress somewhat from orthodox rules and suggest some changes which are more or less startling, depending upon the amount of thought that has been given the subject. When the matter was first presented to me it did not strike me favorably, but as I considered the question further I became convinced that the innovation would sooner or later be adopted.

There are three danger points in electric light plants: First, the switchboard; second, the cut-out cabinets; and third, the liability of ground on a circuit.

Grounds can be avoided by the use of good wire, by using insulators to carry all risers and feeders, and by distributing in moulding and interior conduit as described. I would consider that a model plant, in a modern office or hotel building, would consist of no less than three and not more than five dynamos, a slate switch-board properly mounted with instruments arranged tastefully thereon, the best quality of rubber covered, braided and slicked wire, mains and feeders run upon porcelain or glass insulators, cut-out cabinets made of slate or marble, something after the fashion of that shown in Fig. 3, with all connections on the face. Up to this point the plant would have been made according to the best and most approved system of wiring, but here I would make a departure, by bunching my distributing wires together, wires of opposite polarity being placed side by side in the same raceways, as shown in Fig. 4. This raceway would be lined with asbestos paper, with several coats of a good fire-proof paint, or made of fire-proof material throughout. Opposite each room I would place an individual distributor similar to that already shown. The greatest amount of current to be allowed on one circuit I would make eight amperes. I would so construct my fuse block that it would be impossible to place a fuse therein with a greater carrying capacity than eight amperes. No fixture could be used unless it be provided with an insulating joint, which must also carry the canopy. It is quite a common thing to place a good insulating joint on a fixture with a canopy which grounds the fixture by shunting the joint.

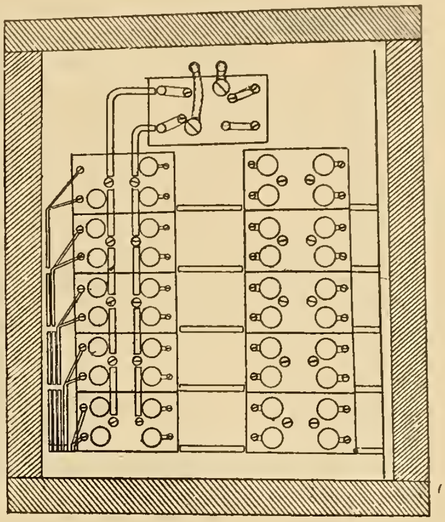

FIG. 3.

Fig. 5 shows the common method of insulating (?) fixtures. Electric gas lighting work would not be accepted on my fixtures unless the same quality of wire was used as in the rest of the installation. No ground would be permitted in the gas lighting circuit. No drop cord smaller than No. 16 B & S could be used and no wire smaller than No. 14. These suggestions I am satisfied are in the line of better and cheaper construction. The reasons are: First, wires placed behind the cut-out box are generally arranged in such a manner as to make it almost impossible to trace them, which is in violation of the board rule that all wires should be accessible for repairs and renewal at any time; second, the bunching of wires is a cheaper and neater method of running than where opposite polarities are separated.

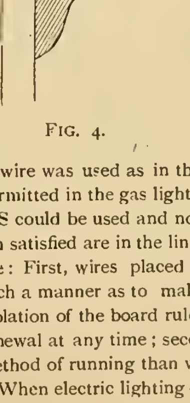

FIG. 4.

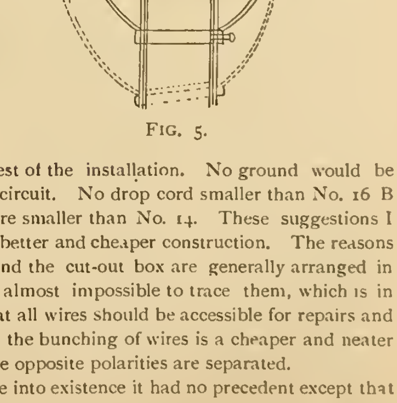

FIG. 5.

When electric lighting came into existence it had no precedent except that of telegraph work and rules, hence telegraph practice was followed. Wires were separated as far as possible; it was argued by many that wires of like polarity should be kept apart for fear there might be a difference of polarity between them, and in one case no longer ago than last summer an insurance inspector insisted that the wires of a loop running to a switch were of different polarity and liable to short circuit.

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* At this point Mr. Armstrong displayed photographic views of switch-board, typical of the principal lighting system installed in Chicago, and incidentally described the most prominent and characteristic features of each.

The safety valve of electric lighting is the fuse. The most dangerous current that we can have is known by some as the "sneak" current and is one that is so slight as not to affect the fuse and open the circuit. The indiscriminate mixing of polarities is especially to protect us against the "sneak" current. With the present system wires become bruised at a certain point, the insulation is injured, the breaking of a water pipe causes a ground, electrolysis takes place, the wire becomes oxidized and attenuated, and finally causes an arc, which may result in a fire. In the system which I am describing a short circuit would very quickly develop and the fuse would be blown, which would warn the electrician that something was wrong. Repeated blowing of fuses would cause an investigation, the trouble would be discovered and remedied. Danger from short circuiting would be comparatively nothing, for the faithful fuse, ever on duty, would give warning of danger. In fact, it would not require a great stretch of imagination to conceive of placing a false lining on the door of the cut-out cabinet in such a manner that the blowing of the fuse would indicate on an annunciator in the engine room where the fuse had blown, thus notifying the engineer in advance of the inevitable angry tenant.

As to the use of eight amperes on a circuit instead of eight lights, as is the present rule in Chicago, I believe there can be no serious objection made. "Lights" is an indefinite term and depends entirely upon the voltage employed for its value in current. The only object of limiting the amount of current on circuits is to reduce the liabilty to destroy sockets by short circuiting. Experience has convinced me that eight amperes properly protected by an eight ampere fuse will not destroy a socket by short circuiting. If the fuse is warm and other lights are on the circuit there is not the slightest danger of injuring it.

To conclude, I will say that the plant designed after the plan outlined would have an economical range in the dynamo capacity, and an economical loss in the wires, which, by the way, is a point that many do not seem to appreciate; in fact, one building is being wired to-day in Chicago with wires several times larger than needed, the owner probably following the logic of the man who drank the whole bottle of medicine with the remark that "if some of it was good more was better," or the son of the Orient who went to purchase a pair of shoes, found that whereas a pair of No. 6 would exactly fit him, that a pair of No. 12 would cost the same money, so he took the No. 12 shoes.

A plant should be designed with a very small loss at the average load; this loss will vary with the character of the building. Very few buildings operateany where near their full capacity at any one time, but if they should for a few minutes in the day require their full capacity the excessive cost of coal expended for that short time would nearly compensate for the interest on the copper, which is a fixed charge against the plant.

This method would reduce the cost of distributing to a minimum, danger of grounds would be almost entirely removed, and with improved fixture connections I doubt whether a better plant could be devised.

It is true that this plant would not coincide with the city inspection rules of Chicago to-day, but the history of our inspection department has been one of incessant warfare against bad work and in favor of better and safer installations. The gentlemen who compose Prof. Barrett's staff are progressive, active, and thoroughly alive to the interest of the electrical profession, and I am satisfied are willing to make any change or alteration in the present rules that would make our work better, safer and more in accordance with good engineering; and we all feel that they are working to accomplish this laudable object. When I say that these gentlemen are working I wish it understood that I mean it literally. When you consider that four inspectors are required to thoroughly inspect 498 isolated stations operating 646 arc lamps and 132,521 incandescents, and 21 central stations operating 9,300 arcs and 150,000 incandescen lamps, all of which are irregularly distributed over 174 square miles, you will understand that they have plenty to occupy their minds and time.

TRADE NOTES.

The Montreal Electric Company, 302 St., James St. have been appointed sole agents for the province of Quebec for the Crocker-Wheeler motors.

The Robb Engineering Co., Amherst, N. S., recently received orders for a 125 horse-power Monarch Economic boiler for the I. C. R. shops at Moncton, N. B.; 125 horse-power Robb Armstrong automatic engine for an electric station at Lethbridge, N. W. T.; and a 150 horse-power Monarch Economic boiler for a woollen factory at Preston, Ont.

Mr. John A. Burns, of Montreal, has secured the agency for that city for the Kay Electric Works, of Hamilton, Ont. The excellent workmanship and well known features of their machines need no recommendation on our part, and we have no doubt but that their interest will be well looked after by Mr. Burns, who has had an extensive experience in some of the largest engineering works in Canada and the United States, and is also a graduate of McGill University, Montreal.

There is a scheme on foot to build an electric railway line between Deschene mills and Aylmer, a distance of about three miles. Mr. R. H. Conroy, warden of the county of Ottawa, is the principal promoter of the movement.

THE CORLISS ENGINE.*

The valve that is used in the Corliss is by no means a new thing, and it is a fact that all of the principal valves in use today were conceived and tried in the early days of the steam engine, but the time was not ripe for their use. The slide, the gridiron, the rotary, piston, rocking, and poppet valves were all old enough when Corliss commenced first to work on the steam engine, although the minor details may not have been the same, but these are constantly changing. The Corliss engine is noted for its valve motion, not its valve. Corliss could have chosen the gridiron valve to put his ideas into practice upon, or any other, but the rocking valve answered best his purpose. The rocking valve is by no means an ideal valve, but it possesses some advantages. The best feature is that it can be extended clear across the cylinder and placed very near the cylinder, thus reducing the waste or clearance space between the valve face and the piston head, at the end of its stroke, and in addition by the use of a fair valve system, the steam and exhaust passages are short and direct. Its great length makes a very slight opening of the port represent a considerable area of opening, and the movement of the valve need not be very great to make a considerable area of opening of the valve. The valve is very quick in reaching a full opening, and if the motion given the valve is also very rapid, the port is opened extremely rapid. These are important points to the advantage of the Corliss engine valve—the small clearances and the quick opening; and as the valve motion is one that gives a particularly quick movement to the valve it is very quick in action.

The valve has this against it, that it is hard to keep tight. To do this it must fit its seat well, and no grit or substances must be allowed to cut this seat, for once a leak begins the cutting action of the steam makes the leak extend very rapidly. It is not an easy matter to remedy this leak after it has once commenced. The valve chambers must be re-bored, and unless the leak is stopped a considerable loss ensues. It is a fact, too that leakage past the steam valves exists more than is generally admitted, and represents a considerable loss even though the steam is used again for heating purposes. Men put up with leakage that they know exists in an engine and satisfy themselves by saying, it is'nt wasted, for it goes to heat the feed water or to do this heating, and all there is about it is that we use the engine as a reducing valve instead of using a separate reducing valve. It is a fact, usually that the legitimate exhaust from an engine is sufficient to do this work, and this being so all that leaks past the valve is pure loss. The Corliss valve may not show any more leakage than the Brown or Putnam under the same care, perhaps not so much as the two latter, but it is far from being a perfect valve in this respect. The old valves were much worse than those of the present day, for they were hung turning in bearings, while to-day they rest upon the seat, the valve being held against the seat by springs or the pressure of the steam. The insufficient warming up of the engine before starting up produces unequal expansion of the valve and its seat, and wear in spots follows and, of course, a leaky valve. The valve is not balanced and the friction item is an important one. This defect is one of varying magnitude, according as the valve allows steam to get underneath it or not. The plain slide valve, with the pressure squarely upon it, will sweep the steam from beneath it on a true seat. A Corliss or any rotating valve has not this tendency and instead is inclined to lift and allow steam to get beneath it and its seat, and this in a measure balances it. The friction of the valves is therefore greater in some Corliss engines than in others, and it is undoubtedly less when the engine is running than when starting up. A leaky Corliss valve is also in a measure balanced, so that whether the valve possesses excessive friction or not comes back to the practical consideration of the matter in its practical operation. It does not always show friction, but it is not like the piston and balanced slides of high-speed engines, which are under all conditions working with the least friction. Their great defect, then, lies in their tendency to leak, the wearing of the valve seat unequally at different cut-offs requiring a frequent use of the boring machine.

The fact that the valve extends clear across the cylinder makes so wide an opening for a full admission of steam unnecessary. The ordinary Corliss engine has a single-ported steam valve, but some attempts have been make to give it double ports. The Trenton valve, Fig. 1, has a single port to the cylinder, but two passages through the valve so as to make a very slight movement of the valve give a full port opening, a quick port opening and, of course, a quick closure. The new Wright valve is a gridiron Corliss with a single port to the cylinder, and in some of the Reynolds-Corliss engines, instead of placing the valves on top and beneath the cylinder, place them in the heads, as in Fig. 2.

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*Abstract of lecture delivered by Thomas Hawley, in the Lowell Course at Wells Memorial Institute, Boston, Mass.

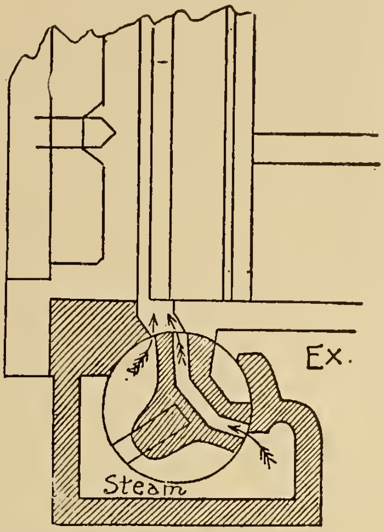

Fig. 1.

The object of this construction was to give a short travel and wide port opening at the high speed run, 100 revolutions per minute and least clearance. It is obvious, of course, that the chances of leakage are increased by thus multiplying the extent of edges exposed to the steam. The lap of the valve edges must be decreased, and in doing so we get back to one of the defects of the early Corliss engines, of insufficient lappage, causing more leakage.

It is quite clear, I think that a valve of itself must have defects, but its merits will depend very much upon the valve gear by which it is operated. On the continent of Europe a Corliss engine is any engine with a detachable cut-off gear, though the valves may be poppet or anything but what we know as the Corliss. This is, in a great measure, right; and, though many people will have a Corliss engine nothing but what it is, yet the great beauty of the Corliss engine is its valve motion, and it is its valve motion that made for it the important position it holds to-day as the best of steam engines. The motion is calculated to fill what is best of the different functions of the valve. It will open the steam valve rapidly, it will hold it wide open until the time it is to be closed, and it will remain closed, without movement, until again to be used. In short, it operates rapidly when in motion, and when not opening or closing is at rest. The same is true of the poppet valve of the Putnam engine, and in the Brown less so. This lingering or dwelling of the valve when opened or closed, is caused by the position of the wrist plate and connections. If we take a skeleton outline of the wrist plate and connections, as in Fig. 3, they are, in effect, like a number of levers, each independent, except that they derive their motion from a single shaft. The eccentric rocks these levers back and forth in a certain arc, and they rock the valve over a certain path to uncover and cover the ports. That is all there is to it except the trip gear.

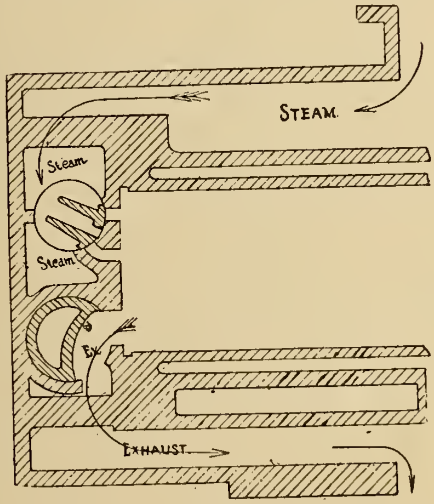

Fig. 2.

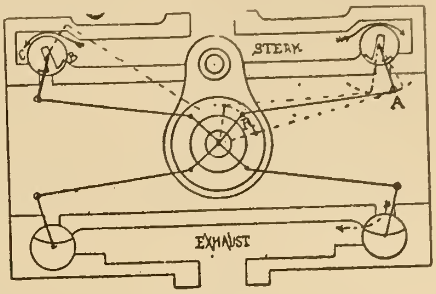

Fig. 3.

Take one of these valves and connections, as in Fig. 4, you will observe that the opening movement of the valve comes when the wrist-plate connections are in such position that the full movement of the wrist plate is given to the valve, the skeleton "levers" being then in position, *a a*. If the opening of the valve should take place when the "levers" were in position, *b b* it will be seen that the wrist plate would have a considerable circular motion before moving the valve at all, hence the more the "levers," *a a*, are at right angles to each other, the more alike will the movement of wrist plate and valve be. This construction gives a rapidity of motion in opening and a dwell when open that is important, and in the case of the exhaust, particularly so, since that is positive in its motions, opening quickly, barely moving when open, closing quickly and hardly moving when closed.

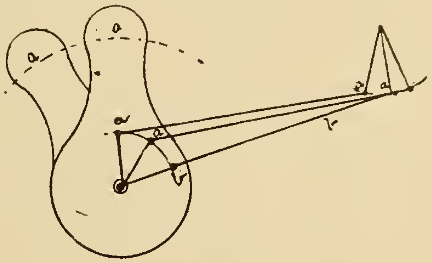

Fig. 4.

The original Corliss had the wrist plate situated half way down the frame and long connection rods to the steam and exhaust valves. The dash pots were also horizontal, and attached to the frame, the dash pot rods running lengthwise of the engine. This construction has one advantage, that the influence of the heat of the cylinder was not noticed as now, the present construction making the valves act slightly different when hot than cold. The placing of the wrist plate on the side of the cylinder obviated the difficulty that was found in the spring of the long connections, and while with the old Corliss one of the valves opened toward the centre and the other away from the centre, the ordinary construction to-day makes them open one way. In the case of the ordinary Corliss the valve opens toward the centre of the cylinder, and in modifications opens away from the centre of the cylinder, so the steam does not have to pass over the valve to enter the cylinder. The tendency of the Corliss original shop is to increase the angularity of the connections so as to give an even quicker motion to the valve than was

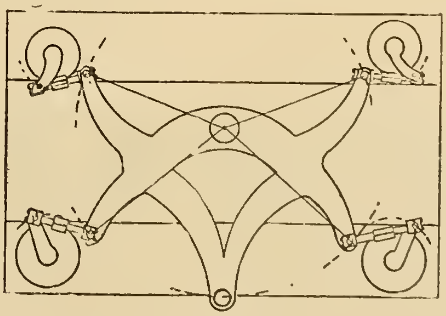

Fig. 5.

possible under the old arrangement. This has led to the adoption of a wrist plate like this, Fig. 5. It is a fact that the full pressure of steam may be realized in the cylinder of the engine, even though the port is not wide open. It follows, then, that any opening of the port after this point is reached is useless, but the valve must continue to move forward some or the trip could not have a chance to operate. The cut-off of the valve must not be considered as taking place until the valve has actually closed. The valve may be tripped and still slow in closing, showing a wire drawing of the steam. A sluggish dash pot will aggravate this trouble, and in any event there must be some time consumed in closing the valve. With the Corliss that time is very little. The action of the tripping is likely to give shocks to the governor, even though the dash pot prevents, in a measure, the oscillation.

The particular fault with the valve motion of this engine is that it does not permit of a sufficient degree of compression being given the engine without affecting the release. The exhaust valves are large enough, and open rapidly enough to make a quick, free exhaust, with very little back pressure. The time of release may be changed by lengthening the right and lefts, but to obtain more compression the right and lefts must be lengthened. This action makes the release later, and before you know it the release is at the end of the stroke, and no more can be done. To give the eccentric more angular advance will increase the compression, but at the sacrifice of the range of cut-off, and making the valve open slower. To obviate this difficulty of obtaining considerable compression without a release too late, some engineers place two eccentrics upon their engine, one for the steam and one for exhaust valves, and set their exhaust eccentric with sufficient angular advance to give the proper compression. Another scheme proposed is to make the exhaust ports nearer the centre of the cylinder, so that the piston will completely cover it in a portion of each return stroke. The covering of the port by the piston confines the steam and allows it to be compressed, the exhaust valves caring for the release. This gives a fixed compression. The weight of the dash-pot piston and connections is to cause wear to appear, causing the stuffing boxes of the valve stems to wear oval. In the Wright engine the wrist-plate is made in two parts, one portion being in engagement with the tripping gear so that the tripping comes at the wrist plate, which is more able to stand the shock than the valve stems.

In setting the valves of the Corliss engine it should be done first by the marks and then with the indicator. The first thing to do is to place the wrist plate in its central position. Upon the stud or pin supporting the wrist plate will be found a mark, and upon the wrist plate three marks, the central one of which should coincide with the mark upon the stud when the plate is in its central position. Upon removing the bonnets from the back end of the valves we will find upon the end of the valve a mark, and that mark coincides or is in line with the opening edge of the valve, and upon the valve seat are two marks that correspond with the edges of the port, showing its location and width. It might be well to verify these marks, but after that is done, or assuming the marks are right, we can set the valve by these marks, two showing where the port is, and the one on the valve, the edge of the valve, *b c* on the valve seat show the location of the port as shown by the drawing, Fig. 6. With the wrist plate in its central position, the steam valves on each end should overlap equal distances, ¼ inch for an 18-inch cylinder and up to ½ inch for a 36 inch cylinder, and the exhaust port may be a little open, usually one-sixteenth of an inch for an 18-inch cylinder, and ⅜-inch for a 36-inch cylinder. The object is to get all alike and squared. If they do not appear alike, turn each of the right and left connections until they do. The valves are then squared. See next that the rocker arm rocks equal distances each side of a plumb line, and if not, cause it to do so by taking up between the rocker arm and eccentric. Next hook the carrier rod to the wrist plate, and by turning the engine over see if the wrist plate moves equal distances on each side of its central position. There being three marks upon the wrist plate this is easily seen, Fig. 7.

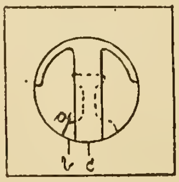

FIG. 6.

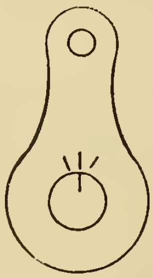

FIG. 7.

If the wrist plate does not move equal distances each side of a plumb line cause it to do so by taking up on the carrier-arm connections wherever it can be done, and if there are no means of taking up there it must be done at the eccentric rod, but only after the rocker arm has been squared. The point is to have the wrist plate vibrate evenly. Now, when this is done, and the wrist plate hooked in, turn the engine on the centre and set the eccentric in the direction the engine is to run so that the steam valve on the end which is to take steam will be open about one thirty-second to one sixteenth of an inch. It should be kept small as possible. If the valve had no lap or lead the eccentric would be set at 90° angular advance, and any advance from this position will cause the opening to be slower and diminish the range of cut off.

The next point is the governor. The long rods from governor transmit the motion of the governor to the cut off mechanism and adjust it to trip the steam valve. By changing the length of these rods the point at which the valve will be tripped for a certain position of the governor is altered. Block the governor in its highest position, and adjust the long rods so that the valve will trip before the steam port is opened, that it will trip before the lap is uncovered, or no more than touch the steam valve. This can be determined by working the valves with the bar in the wrist plate. Then drop the governor to its lowest point and see if valves do not trip at that point. If, when the average load is on as determined by the indicator, the cards are unequal in area, as will probably be the case, change the governor rods so that the end doing the most work will trip a little earlier, and the one doing the least work, a little later. If the card should be a little late all around, set the eccentric ahead a trifle. If it is then desired to change any particular point, shortening the right and left will give more lead, and decreasing it, less lead. By shortening the exhaust connections, the release will be earlier and the compression decreased, while lengthening these connections makes exhaust take place later and increases the compression.

THE REAL INVENTOR OF TELEGRAPHY.

SAYS a writer in the *Popular Science Monthly* for February, Weber was the first who established a permanent workable telegraph line, and thereby demonstrated the practical value of electric telegraph. Weber's house in this city was connected with the astronomical and magnetic observatories by a line three or four kilometers (over two miles) in length. The signals were made by the deviations of the needle of a galvanometer to the right and left, and were interpreted according to a conventional alphabet. The use of interrupted or reversed currents did not permit the transmission of more than one or two words a minute, but the speed was increased to seven or eight words by the use of induced currents. The following first notice of this telegraphic connection was published in one of the numbers of the *Gottingen Gelehrten Anzeigen* (or Gottingen Scientific Notes) for 1834: "We cannot omit to mention an important and, in its way, unique feature in close connection with the arrangements we have described [of the Physical Observatory], which we owe to our Professor Weber. He last year stretched a double connecting wire from the cabinet of physics over the houses of the city to the observatory; in this a grand galvanic chain is established, in which the current is carried through about nine thousand feet of wire. The wire of the chain is chiefly copper wire, known in the trade as No. 3. The certainty and exactness with which one can control, by means of the commutator, the direction of the current and the movement of the needle depending upon it were demonstrated last year by successful application to telegraphic signalizing of the whole words and short phrases. There is no doubt that it will be possible to establish immediate telegraphic communication between two stations at considerable distances from one another."

ELECTRIC RAILWAY DEPARTMENT.

TORONTO AND MIMICO ELECTRIC RAILWAY.

It is reported that negotiations are under way and will speedily be consummated for the purchase of the above road by the Toronto Street Railway Company. The present owners of the road appear to have had a by no means pleasant experience. They have for some time been engaged in litigation with the builders of the road, the Reliance Electric Mfg. Co., arising out of their claim that the plant installed for the purpose of operating the road is defective, and that to this cause was due the fact that the road ceased operations after having been running for a couple of months last year. Again the company has been involved in litigation with persons resident in the township of Etobicoke, with the object of securing payment of a bonus of $10,000 granted to the company by a vote of the ratepayers under a by-law of the municipality. The line, if properly operated, should prove a profitable one in the summer months at least, when thousands of the citizens are weekly visitors to High Park and the Humber.

ECONOMICAL OPERATION OF STREET RAILWAYS.

Mr. A. B. Johnson, in writing on this subject to *Electricity* of New York, says :—I think it can be reasonably claimed that any route where the travel will warrant the installation of a horse railroad, can be more economically operated by means of electricity, provided the water supply is ample, and the cost of the fuel is not exorbitant.

It is in just such cases, however, where the conditions for success are the most restricted, that a system of false economy is most apt to be practiced. Managers of small roads will argue that their business will not warrant the expense of employing a competent electrician, and in consequence, men are often found in charge of electrical plants and railway equipments whose knowledge is limited to the operation of replacing burnt out armatures, which under these conditions, is an operation of unnecessarily frequent occurrence. A case illustrating this, recently came under my notice, in which an armature, which had been running for over six months without a particle of attention or inspection, was suddenly burnt out.

This was replaced by three others, successively, which met with the same fate. On examination it was found that the armature brushing had worn down so much that the armature winding was rubbing on the lower pole piece of the motor.

The "electrician" of the company, after making this discovery, spent two days in patiently chipping out the lower pole piece, until sufficient clearance for the armature was obtained. This remedy had the effect of burning out the armature on the opposite motor, and the case was referred to the company, who installed the plant. This company supplied a new pole piece, two pairs of brushings, five armatures and the services of an expert.

The cost of this experiment, covering a period of five days, would have paid the salary of a competent electrician for more than six months. This is undoubtedly an unusual and, it is to be hoped, isolated case, but it serves to illustrate the folly of intrusting the care of electrical machinery to men who have no knowledge, either theoretical or practical, of its requirements.

The idea that electrical machinery is indestructible is fast losing ground with railway companies and it is now the rule to find competent men in charge of electrical equipments, but it is difficult to surmise why such an opinion has ever existed. In installations of almost every other class of machinery the greatest care is take and the most competent engineering ability is demanded, but in the case of electrical plants these ordinary precautions are frequently neglected, and while it would be hard to find a case where a steam plant is in charge of a man who knows nothing whatever about an engine, electrical equipments, which are infinitely more susceptible to injury, are often intrusted to men who have not the least knowledge of electricity.

The annual depreciation in the value of a plant is always an important item to which too little attention is apt to be paid, but the care which a railway plant receives will, to a great extent, determine the percentage of its yearly depreciation. It would seem that the expense of equipping a street railway is sufficient to make the saving of two or three cent. per annum on the investment an object of very careful consideration. This question of depreciation is sure to be an important one with this class of machinery, and every care should be taken to increase the life of such an equipment. The renewal of the plant is sometimes a matter of great expense to companies who have allowed their machinery to run down until it is useless, while the entire cost of keeping it in good order from day to day would be hardly felt in comparison.

There can be no doubt that the supervision of a competent man will save any railway company several times the amount of his salary, in averting accidents by intelligent foresight, and at the end of five years the value of the plant will be probably twice as much as in the case where it is permitted to take care of itself.

The Berne, Switzerland, compressed air tramway is at present exciting a good deal of interest. The peculiar feature of this system, which is known as Mekarski's, is, according to the *Street Railway Gazette*, that steam is mixed with the compressed air—in order to keep its temperature from falling too much when the pressure is lowered—and so reducing the air pressure to a point too low for use on the engines. The air is compressed in a central compressing station, and after passing through dryers is sent out in pipes to the so-called accumulator stations, where it is stored in tanks preparatory to delivery to the car. At these accumulator stations are also the boilers furnishing the steam to be mixed with the air. The motors are like a common steam motor, and the storage tanks are under the car floor.

The Ottawa Electric Street Railway Company are enlarging their power house and intend putting in larger motors in the place of the ones now in use. The company have extended their line to Rockliffe, but say that even with the lines now in operation they require additional power.

Messrs. C. and J. F. Beck and others have been granted incorporation as the Penetanguishene & Midland Electric Street Railway, Light and Power Co. The capital of the company is $75,000. Mr. Holgate, C. E., and his staff are engaged in surveying the road, and it is expected that construction will soon be commenced. The company intend to carry freight as well as passengers.

The Montreal Street Railway Company's new power house, of which mention was made in the last issue of the Electrical News, will contain an engine and dynamo room 160 feet by 85 feet, and a boiler room 100 feet by 80 feet, and will be built of brick and stone. Messrs. J. Laurie & Bro., of Montreal, are now engaged in the construction of the twelve generators which are to furnish the power, and which will be driven by six steam jacketted, compound condensing Corliss engines of 600 h. p. each. The high pressure cylinders will be 24 in. in diameter by 48 in. stroke ; the low pressure cylinders 48 in. diameter by 48 in. stroke. The shafts will be of steel, 15 in. diameter in the centre and with 13 in. journals. The fly wheels are to be 22 feet in diameter, 44 in. face, with a weight of about 40 tons each. The cost of the engines will be $75,000, and the weight over 500 tons.

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In reply to Mr. Cockburn's inquiry, Mr. Wood, Controller of Inland Revenue, has stated that the Government do not intend to introduce a bill for the inspection of electric light.

The Northwest Transportation Co. has let the contracts for lighting their boats. There will be one engine of the Armington & Sims pattern for each boat, and they will be furnished by Messrs. Nie & Lynch, of Hamilton, while Messrs. Ahearn & Soper will complete the work and furnish all material.

The Canadian General Electric Co., of Peterboro', have completed the fourth of the locomotives they have been building for the Vancouver Coal Co. The average speed will be about 8 miles per hour, the grading in the mine being very irregular. The current will be delivered at 3,000 volts, but will be reduced to 50 volts at the locomotive.

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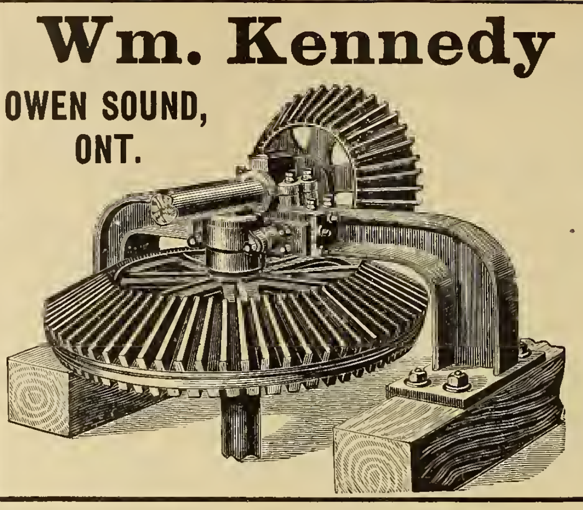

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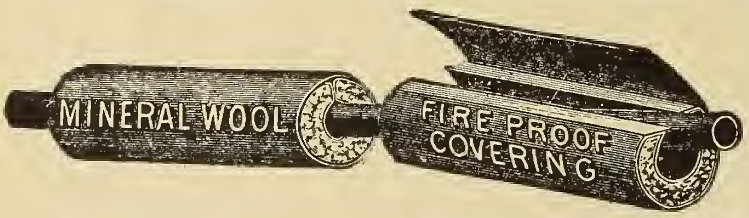

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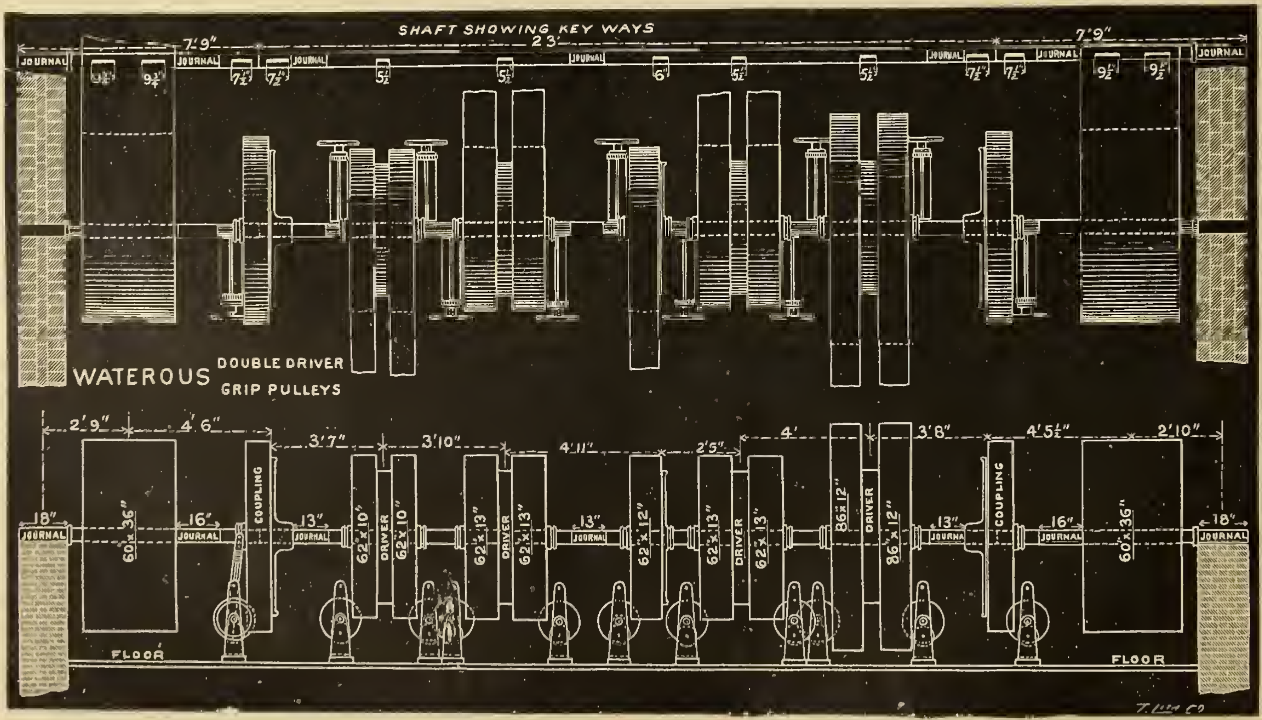

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WATEROUS, BRANTFORD, CANADA

SPARKS.

The name of the Guelph Gas Company has been changed by an order-in-council to the Guelph Light and Power Company.

Messrs. McColl Bros. & Co., of Toronto, have formed a company and are being incorporated under the name of The McColl Oil Company, of Toronto.

Mr. T. Ahearn, of Ottawa, has returned from a trip through Mexico and Central and South America, where, he states, very little progress in electrical matters has been made, owing to political difficulties.

The St. Catharines Electric Street Railway Co. have relaid the track from Thorold to St. Catharines and intend to commence work shortly on the extension to Port Dalhousie. They have also built a large and handsome car stable.

Mr. J. W. McRae, president of the Ottawa Electric Street Railway Co., states that it is the intention of the company to put in a steam plant, so that in case of low water they can have steam to fall back on. During March last, when the water was low, they had considerable trouble. They with a number of others interested also propose to deepen the channel so as to obtain a greater head of water.

The Montreal Electric Club held its last meeting for the season on May 29th. An instructive paper was read by Mr. H. Ritchie on "Testing Dynamos and Motors," and the secretary-treasurer afterwards presented a report, showing the club to be in a flourishing condition financially and the membership to be increasing satisfactorily. The meeting then adjourned to meet at the call of the president next September.

FREDERICTON, N.B., June 10th, 1893.

TENDERS

Will be received, addressed "City Clerk, Fredericton, N. B.," for

Lighting the Streets of said City by Electricity (arc lights),

said tenders to be received until 14TH DAY OF JULY NEXT, at noon. Fifty arc lights will be required, to be run per "Moonlight Schedule." A contract will be entered into (if terms satisfactory) to run ten years. The contractor will be required to furnish, put in and run dynamos, machinery, all plant and materials at his own charges in all things. Any further information will be furnished on application. Each tender to state description of machinery and light proposed to be furnished. The lowest or any tender not necessarily accepted.

By order of Street Light Committee,

CHAS. W. BECKWITH,
City Clerk.

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One 36 inch belt 100 feet long. One 38 inch belt 100 feet long.
One 36 inch belt 123 feet long. One 24 inch belt 100 feet long.
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SPARKS.

St. Cunegonde, Que., has been equipped with complete electric fire alarm and police signal systems by Mr. N. Simoneau, of Montreal, who was awarded the contract for the work.

In another part of this paper the city of Fredericton, N. B., invites tenders for electric street lighting. Mr. Chas. W. Beckwith, City Clerk, writes as follows: "I may say that we have a company here to whom we pay about $2,000 for 62 gas lights, and as they also run an electric system (the only one in the city) they will not furnish us with electric street lights at any reasonable figure, preferring to keep us to the old gas lights. We are therefore seeking some advance, and if satisfactory tenders are received, are in a position to close a contract on terms advertised."

The gigantic undertaking of harnessing Niagara is rapidly nearing completion, and when finished will be one of the triumphs of the nineteenth century. The large tunnel through which the water will have to pass after being utilized to rotate the large turbines is nearing completion, and the total length of the tunnel is 7,000 feet; 19 feet wide and 21 feet high. The immense shaft in which the turbines will be situated is sunk to a depth of 200 feet. Turbines of enormous size and capable of producing 5,000 horse power each will be used, the largest ever constructed. Large dynamos will be vertically coupled directly to the main shaft, so that no power will be lost through the means of belting, and the electric current generated will be used to furnish power, heat and lighting. This large undertaking is engineered over by G. B. Burbank, of New Aqueduct fame, and Prof. Geo. Forbes, the great English electrician. On the Canadian side work is finished. In this case the water power is obtained from a cut leading from the river of about 100 feet in length, at the end of which the sluice gates are situated; thence a fall of eighty feet, the waste water passing through a tunnel situated below the Falls. In this case two turbines of 1,000 horse power each are used. The current furnished will be used to operate the electric railway, which is now built, running from Queenston along the brink of the river to the prettily situated village of Chippewa. On every pole used to suspend the wire between the Clifton House and Queen Victoria Park, there are situated six 16 candle power lamps, which will be lit up at night, making it one of the prettiest rides imaginable.

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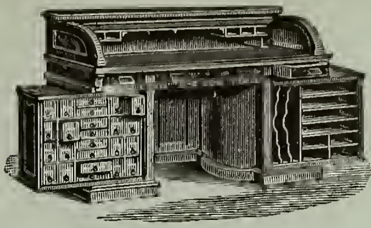

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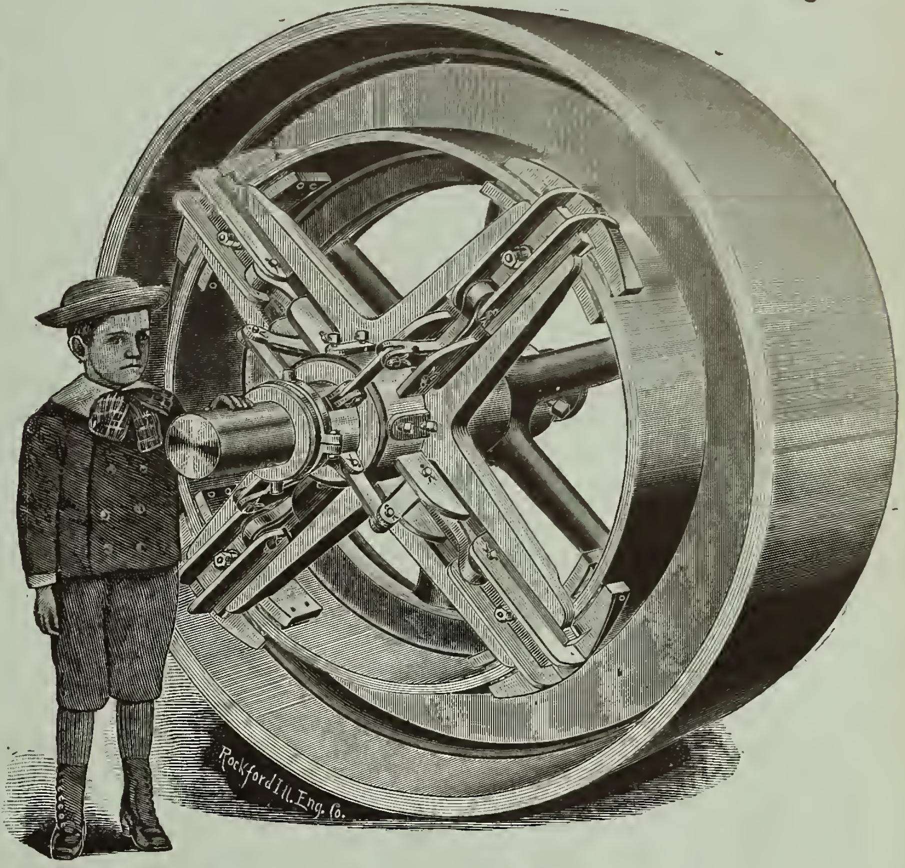
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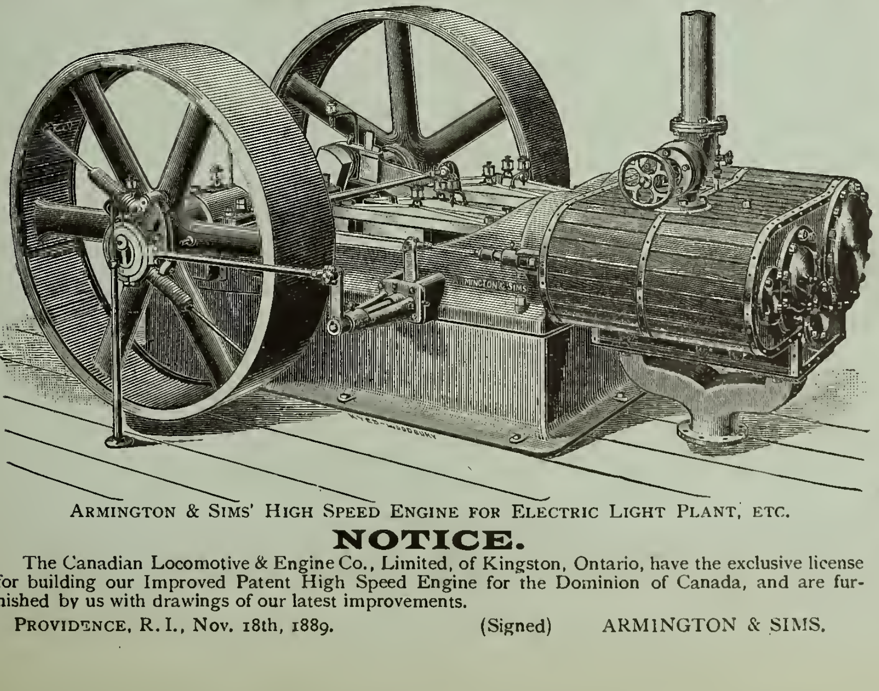

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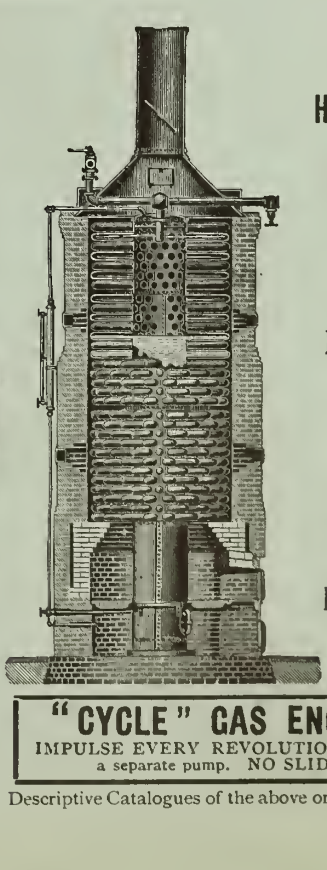

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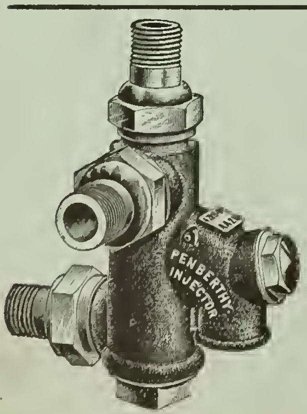

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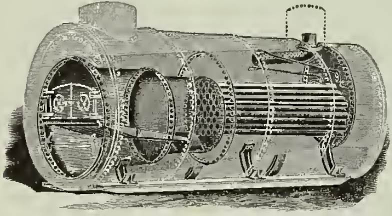

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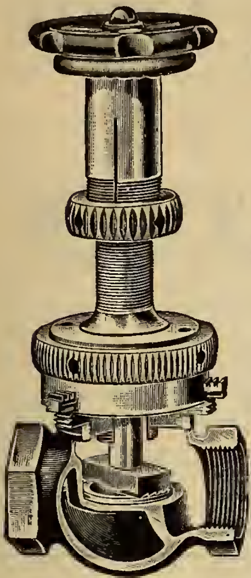

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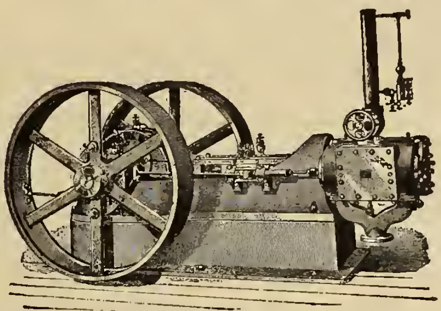

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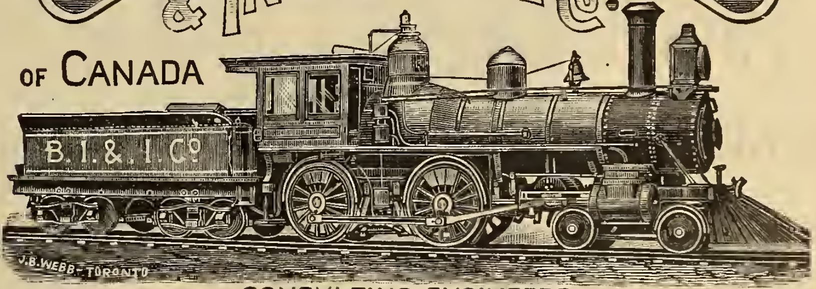

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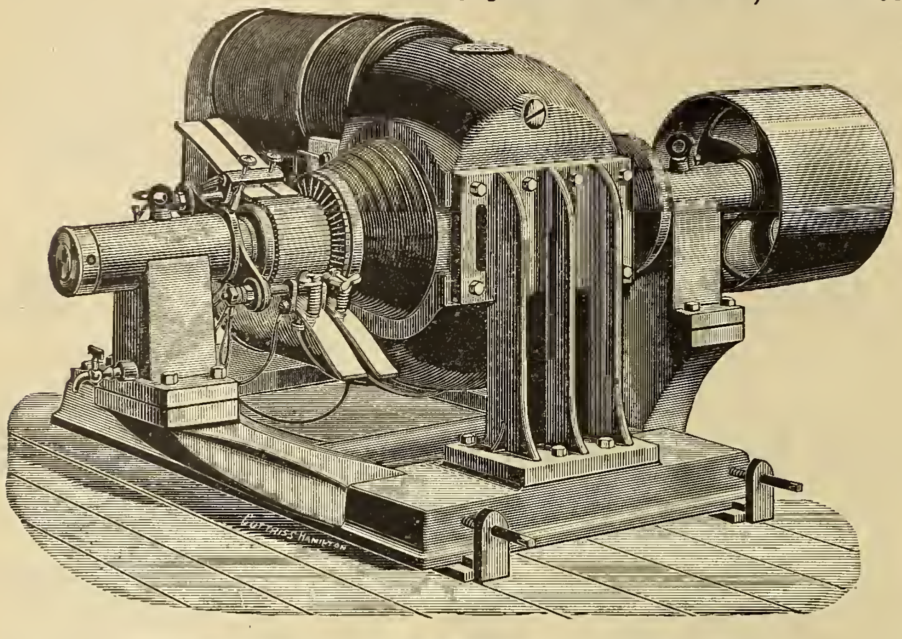

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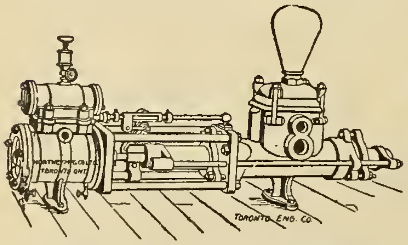

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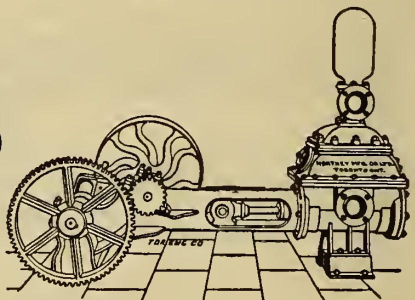
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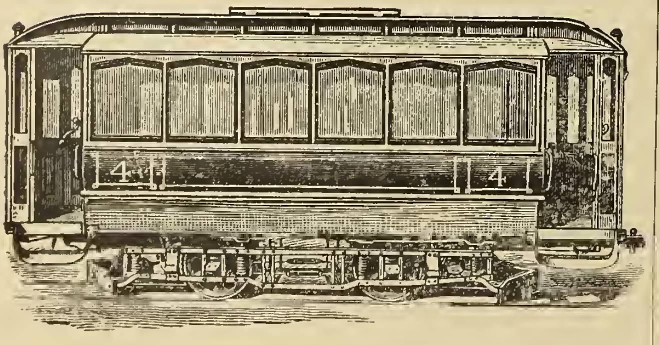

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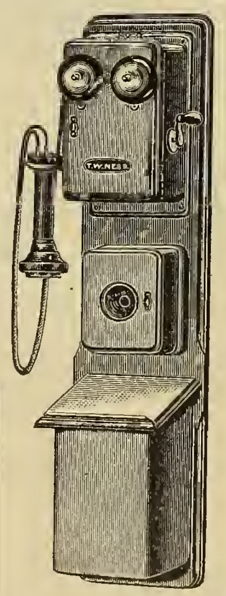

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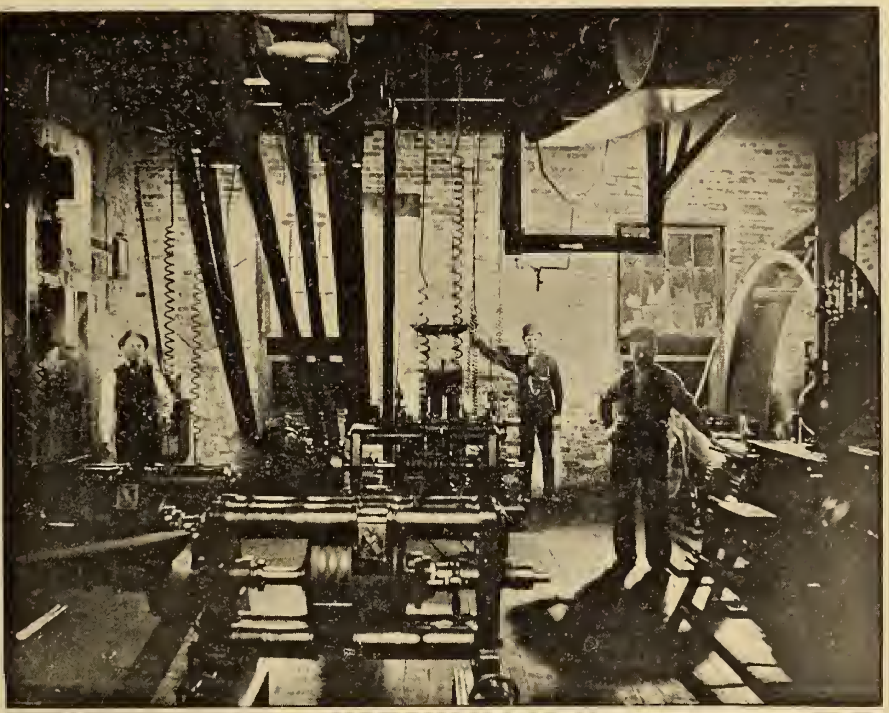
ELECTRIC LIGHT STATION, ST. THOMAS, ONT.

THE accompanying illustration, reproduced from a photograph kindly furnished us by Mr. F. Revell, shows the interior of the electric lighting station of the St. Thomas Gas Company, St. Thomas, Ont. In 1887 the Gas Company introduced electric arc lighting by installing a Royal ½ arc dynamo of 50 lamps capacity. Since that time the Company have made many changes and improvements in the plant, which at present consists of three Reliance arc dynamos of 25 lamps each, one Westinghouse alternator and exciter of a capacity of 750 16 c. p. lamps; a 60 h. p. Corliss engine manufactured by Messrs. John Inglis & Sons, Toronto, and a 50 h. p. Leonard-Ball engine. The Company are now about to install a 90 h. p. Reliance generator, and are busily engaged in constructing the power circuit.

The Company is under the management of Mr. H. Brown, Mr. F. Revell is the electrician, Mr. G. A. Pretty, lineman, and Mr. W. Noble, trimmer.



Electric Light Station, St. Thomas, Ont.

DEADENING THE NOISE FROM A GAS ENGINE.

AMONG the various engineering investigations which for some time have engaged the attention of mechanical experts is that having in view some ready method for deadening the objectional noise made by puffs from the exaust pipe of the gas engine, but only an indifferent amount of success has hitherto attended these efforts. The most recent contrivance of the kind is a device described in a French journal, and claimed to be simple, and inexpensive. Briefly, a pipe split for a distance of about two metres is attached to the end of the exhaust, with the split end upwards, and, beginning at the lower end of the cut, which may best be made by a saw, dividing the pipe into two halves, the slotted opening is widened out toward the top until it has a width equal in extent to the diameter of the pipe. Under this arrangement the puff of the exhaust spreads out like a fan, and the discharge into the open air takes place gradually, the effect produced depending somewhat on the flare of the tube.

Work has been commenced on the Montreal Street Railway Company's new power house of which mention was made in the last issue of the NEWS. Mr. Everett says the rate of construction of new lines is ten miles per month. A line has been opened on Fulton and St. James Sts. to relieve the cars on Notre Dame and St. Antoine streets.

INTERNATIONAL ELECTRICAL CONGRESS.

IN common with a number of other Canadians interested in electricity, we have been favored with an invitation to attend the International Electrical Congress to be held in connection with the World's Fair, Chicago, on the 21st of August next. A copy of the preliminary program of this Congress is before us. The general Congress will be divided into three sections as follows:

A—The section of Pure Theory, including electric waves, theories of electrolysis, electric conduction, magnetism, etc.

B—The section of theory and practice, including studies of dynamos, motors, storage batteries, mica, wiring, instruments, materials for standards, etc.

C—The section of pure practice, including telegraphy and telephony electric signalling, electric traction, transmission of power, systems of illumination, etc.

These sections will meet for organization and work at 10 a. m., August 22nd.

The following topics will be considered by the Chamber of Delegates:—"Adoption of definition and values of fundamental units of resistance, current and electro-motive force;" "Adoption of definitions and values of magnetic units;" "Adoption of definitions and value of the unit of self-induction;" "Definitions and values of light, energy and other units;" "The consideration of an International system of Notation and Conventional Symbols and of a more uniform and accurate use of terms and phrases in electrical literature;" "A commercial standard of copper resistance". Together with such other topics as may properly come before this body.

Papers have also been invited upon a wide variety of subjects.

Public lectures of a popular character will be delivered by eminent electricians at 8 o'clock, p.m. on Tuesday, Thursday and Friday of the Congress week.

Application for incorporation has been made by the Brockville Light and Power Company.

About 140 omnibuses in London, Eng., are provided with electric light. A small battery, weighing only about 8 pounds, is placed under a seat in a small box having two brass terminals which make contact with the battery. The lamps are small and have horizontal filaments, so that they may not be any inconvenience to passengers. The only work required is the exchange of the battery, and its capacity is such that it only requires once charging for a day's service.

ELECTRICAL EXPERTS.

Editor Canadian Electrical News.

Sir,—As electrical matters are making great progress in Canada I think it might be of interest to Canadians to know how Electrical Experts are made by the different large electrical manufacturing companies. All the electrical apparatus manufactured for lighting and power purposes requires the care and attention which can only be given to it by men understanding their business, and as each large manufacturing company has a particular interest in installing its apparatus, it has also an interest in having a man in charge of that apparatus who knows how to run it. This is one of the reasons why the Expert Course has been instituted.

I will now try to tell you something about the training of an expert as it is done at the works of the Thomson-Houston Electric Co. in Lynn, Mass. A young man desiring to enter the course must be not less than twenty-one years of age, and have received a technical education, such as can be obtained in the School of Practical Science in Toronto or almost any of the Universities, or have had two or more years of practical electrical experience, with of course a fairly good education.

Being able to qualify under either of these conditions, and upon giving proper references his application is accepted. After waiting probably six months for an opening, he will receive a letter from the manager of the expert department saying that his services will be required on we will say Monday morning at 6.45, and on payment of a fee of one hundred dollars he commences his course. The first few weeks will probably be devoted to what is known as "humping"—that is, he may be started in the railway motor department, and for three weeks will set up railway motors for testing, and after they are tested take them down again. This is a splendid department for the cultivation of muscle and an appetite, and as board is rather high in Lynn, it is as well to have an appetite and get all you pay for.

When an "expert" commences the course he may imagine he knows something about electricity, but that feeling soon wears off, and at the end of the railway motor period, he concludes that although he is quite competent to set up a railway motor there are a few things around the factory he never saw before.

In each of the regular departments a certain time is spent, as for example four weeks on railway generators, five weeks on alternators, five weeks on arc machines, etc. Several months are spent on special work, such as making the tests on various machines, helping in work of an experimental nature, some office work, such as writing up data, plotting curves, making corrections in record sheets for errors in the instruments used, as a voltmeter sometimes reads too high or an ammeter too low.

All "experts" commence and quit work at the regular time of all the employees, except office men, viz.: 6.45 a.m. and 6 p.m., and have to wear overalls and jumpers, and do their full share of the work in the different departments, be that work dirty or clean, and this is the only practical way of learning anything about the different machines. For instance, if you actually put the commutator on an arc dynamo once you would understand better how to do it than if some one had told you a hundred times how to do it, but you had never gone through the operation.

The work all through the course is thoroughly practical. A man is not simply told how to run motors, but he is given charge of a number of motors driving machinery in different parts of the factory, and for four weeks he has to start them, stop them, and keep them oiled and cleaned. He may be tired of running motors before four weeks have passed, but if he doesn't know how to run them by that time it is not the fault of the Expert Department. Another thing I may mention is, no one objects to an "expert" asking questions, and as there are so many things to ask about this is quite a boon to an inquisitive man. We heard one youth go so far as to ask which was the positive lead of an alternator. He hasn't found out yet, but knows more about an alternator than he did before asking.

Motor.

"As Others See Us," is the title of a neat pamphlet issued by the Penberthy Injector Co., of Detroit, Mich. It contains letters from many of the largest steam supply houses and traction engine manufacturers in the United States and Canada, all speaking in the highest terms of the celebrated Penberthy Automatic Injector. They are letters which carry weight, as they are from persons who have sold and used this machine for from three to six years.

QUESTIONS AND ANSWERS.

"T. M.," Goderich, writes: Where is the greatest pressure in a steam boiler, at the top or bottom?

Ans.—When a steam boiler is got ready for raising steam and has water in it at the proper level, there is only the pressure of the atmosphere at the surface of the water, but at the bottom of the boiler there is a pressure due to the weight of water. When steam is raised it does not take away the action of the force of gravity, and the hot water still has weight, hence at the top of the boiler there is the pressure due to the steam, which may be measured by the steam gauge. The pressure at the bottom of the boiler, however, is that due to the weight of water and the pressure of steam on the surface of the water. Hence there must be a greater pressure at the bottom than at the top.

"E. P.," Toronto, writes: What is the cause of racing in an Armington & Sims engine when you attempt to speed it up? How can they be speeded up and yet run steady?

Ans.—The governor of the Armington & Smis engine is adjusted for the speed at which engine is to be run. To try to change the speed without a proper understanding of the principles involved in the operation of the governor, would be sure to produce unsatisfactory results. Any attempt on our part to give instructions would in all likelihood only tend to increase the difficulty. The best plan would be to write to the maker of the particular engine, stating at what speed engine has been running and the speed at which it is wanted to run, and ask for instructions.

"Old Subscriber" writes: (1) Can you give me the name of the best book on Galvanism? (2) What steps are necessary in order to undergo examination for certificate of the Ontario Association of Stationary Engineers, and what is the cost of obtaining certificates?

Ans.—(1) It is not clear from our correspondent's letter exactly what character of book he requires. A series of primers treating of electricity and magnetism, and suited to the requirements of students, has been published by the Electrician Publishing Co., Salisbury Court, London, Eng., and would no doubt meet our correspondent's requirements. We would also recommend Desmond's "Electricity for Engineers" as worthy of his attention. (2) Our correspondent should correspond with Mr. A. E. Edkins, 139 Borden street, Toronto, who is chairman of the Board of Examiners, and who if requested will appoint a time and place for the examination to be conducted. The candidate for examination is required to give proof of his experience in engineering, and in order to obtain a 3rd class certificate must have had at least two years practical experience. The cost of a 3rd class certificate is $2, of a 2nd class certificate, $3, and of a first class certificate, $5.

TRADE NOTES.

Messrs. Siemens Bros. & Co., of London, manufacturers of electrical apparatus, have appointed as their Canadian agent, Mr. Jas W. Pyke, 35 St. Francois Xavier st., Montreal, who succeeds in that capacity the late Mr. Geo. Reaves.

The Ball Electric Light Company have supplied the Toronto Board of Trade with an incandescent dynamo; Messrs. Smith Bros., carriage makers, with a 15 h.p. motor; The Oriental Steam Laundry, with a 20 h.p. motor; and George McFarlane, leather merchant, with a 15 h.p. motor.

The Penberthy injector Co., of Detroit, Mich., report that in spite of the dull times their business is steadily increasing. Since completing the additions to their factory, they have added eight new speed and monitor lathes to their plant, also a new Reed Engine Lathe and a Universal Milling Machine to their tool room outfit. The capacity of their works is now 2000 machines a month, and they are yet unable to accumulate any stock, but are frequently behind their orders.

The Northey Manufacturing Company, of Toronto, the well-known manufacturers of pumping machinery, have just removed their business to new and commodious premises erected specially for their accommodation, near the King street sub-way. The main building is 250 feet long, with pattern shops, brass foundry, boiler house, pattern storage, offices and other subsidiary buildings in proportion. The buildings are equipped with machinery plant of the most improved description. Fuel gas is employed for firing the boilers and for heating the factory, forges and melting pots. The factory is lighted by electricity, by which means also the travelling cranes are operated.

In one day recently, the Montreal Street Railway Company carried 106,000 passengers.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of the various Associations are requested to forward us matter for publication in this Department not later than the 20th of each month.

THE ANNUAL MEETING.

Thursday, Friday and Saturday, Sept. 7th, 8th and 9th, are the dates chosen for the annual convention of the Canadian Association of Stationary Engineers, and the place of meeting the City of Montreal.

The time chosen for the convention coinicides with that selected for the Montreal Exposition, and in connection with the Exposition the engineers propose to make an interesting exhibit of models of engineering appliances.

The delegates to the convention will have the advantage of the reduced rates which the railways will offer to visitors to the Exposition. The return fare from Toronto in former years has been about $7.00. At this rate there should be a large attendance.

It is learned that accommodation for delegates from outside of Montreal has been arranged for at the Balmoral Hotel.

We have been informed that the delegates from Toronto, Hamilton, London, and other towns in Western Ontario will probably number about 30. The statement has appeared in print that a considerable delegation is expected from the United States, but what foundation exists therefor, we cannot determine. It is to be hoped, however, that at least some of the Executive officers of the National Association will be in attendance.

Among the papers to be read at this convention is one by Mr. A. M. Wickens, Chief Engineer, Ontario Parliament Buildings, on "Wasted Heat," and one by Mr. Chas. Kinsey, Toronto, on "The Duties of the Engineer Twenty Years Ago as Compared with the Present Day."

Unfortunately the particulars concerning the arrangements and program of the convention have not been made known to the extent that is desired among the members of the Association in the West. It is in the interest of the conveution that the information should be given at the earliest possible moment.

EXAMINERS APPOINTED.

At a recent meeting of the Board of Examiners of the Ontario Association of Stationary Engineers, A. E. Edkins of the Boiler Inspection and Insurance Co., was elected President, in place of the late J. A. Wills, and E. J. Philips, Engineer of the Incandescent Electric Light Co., was elected an Examiner in place of A. E. Edkins.

TORONTO NO. I.

The regular meeting of this Association was held on July 14th. The following officers were installed: Wilson Phillips, president; W. M. Butler, vice-president; Herbert Terry, recording secretary; Geo. Mooring, financial secretary; Sam. Thompson, conductor; John Thompson, doorkeeper. Bros. Mooring, Phillips, Lewis, Gilchrist and Sutton were appointed delegates to the annual meeting in Montreal. Mr. Chas. Heale was appointed as the representative of the Association on the Toronto Technical School Board.

HAMILTON NO. 2.

Two meetings of the above Association have been held since the report of the annual meeting appeared in The News. At the first of these the newly elected officers were installed by Bro. A. M. Wickens, of Toronto. Bro. Edkins, President of the Executive Council, was also present, and by invitation of the President, presided. Both brethren addressed the meeting touching the progress of the C. A. S. E., their remarks being of a very encouraging character. It is the opinion of the members of No. 2 that much of the progress which the order has achieved is due to the indefatigable efforts of these brethren. The Association is always pleased to receive visits from them or from any other brethren whose experience would fit them to impart information to young engineers.

At the second meeting the most important business was the selection of delegates to represent the Association at the annual convention to be held in Montreal in September. The choice fell upon Bros. P. Stott and D. Robinson. Bros. Wm. Sweet and E. Johnson were appointed as alternatives should the delegates first chosen be unable to attend the convention. The gentlemen who have been selected to represent the Association at Montreal are a pair of reliable old-time engineers, who however have not failed to keep themselves posted on every new departure in steam engineering, and may be depended on to give a good account of themselves at the convention in connection with the various subjects which will there come up for consideration.

LONDON NO. 5.

The above Association at its last meeting elected the following officers: Fred Mitchell, president, (acclamation); G. B. Risler, vice-president; Geo. Taylor, secretary-treasurer (acclamation); W. McLean, conductor; Henry Goldhardt, doorkeeper; Wm. Westhead, P. Teene and T. Patterson, trustees. At this meeting two new members were initiated. We are pleased to learn that the London Association is now one of the most prosperous in connection wish the C. A. S. E., having a membership of 30, well officered. If the enthusiasm which at present animates both officers and members be maintained the Association is bound to grow in numbers and influence.

OTTAWA NO. 7.

At the regular meeting of the above Association held on the evening of July 26th, the members were addressed by Bro. A. M. Wickens, of Toronto, President of the Ontario Association, who expressed his gratification at the progress which the C. A. S. E. was making. The attention of the members was specially directed to the clauses in the constitution prohibiting members of the organization from attempting to dictate in any way to their employers. The advisability of establishing evening classes for the instruction of the members was suggested. After a hearty vote of thanks had been tendered to Bro. Wickens, the election of delegates to the approaching annual convention of the C. A. S. E. in Montreal was proceeded with. Bros. J. H. Thompson and Frank Robert proved to be the choice of the meeting.

OBITUARY.

It is our painful duty to chronicle the death on the 22nd of July of Mr. T. B. Griffith, manager of the Hamilton Street Railway Company. Ten days prior to his death Mr. Griffith was prostrated by the heat while out directing the business of the railway. Subsequently the hope was indulged that he would recover, but his constitution had been run down by overwork consequent upon getting the new electric railway into shape, and lacked the strength necessary to rally. Mr. Griffith was recognized as being one of the most energetic and upright citizens of Hamilton, and his loss is deeply felt. He was born in the County of Norfolk, on the 4th of August, 1854, and consequently was at the time of his death in his 39th year. In his earlier days he was for a number of years employed as a telegraph operator and later on as ticket agent by the Great Western Railway Co. He quitted the position last mentioned to assume the management of the Hamilton Street Railway, in which he and his brother, J. B. Griffith, subsequently secured the controlling interest. A wife and five children are left to mourn his loss.

The Town Council of Annapolis, N. S., recently decided to purchase the electric plant which has been used to furnish light for the streets.

A single leather belt will stand a working strain of from forty to fifty pounds to each inch in width, with comparative ease, and double leather from seventy to eighty pounds.

To lessen the noise from gas engines, open the gas exhaust pipe for about three or four feet and open out the halves of the pipes so as to make a flaring outlet; by this means the "bark" will be much lessened. Splitting down the pipe by four cuts instead of two, so that the four parts can be opened out in funnel shape, will be still better.—*Dixse.*

The car building business of Mr. W. W. Wylie, of Ottawa, was on the first of July formally handed over to the Ottawa Manufacturing Car Company, which is applying for incorporation. The provisional directors are: Messrs. W. W. Wylie, T. Ahearn, J. W. McRae, W. Y. Soper and W. Scott.

The Restigouche Telephone and Electric Light Company has been organized at Campbellton. It is the intention to construct a telephone line to Dalhousie, a distance of 16 miles, and to Metapedia, a distance of 12 miles, taking in the principal towns on the Restigouche River. The provisional directors of the Company are: James Reed, George Moffatt, W. W. Doherty, Kilgour Shives, A. E. Alexander, J. P. Mowatt and David Richards.

The ingenious assesssment commissioner for the City of Toronto, in casting about for means to increase the assessment, has decided to tax the mains of the Consumers Gas Company, which are valued at $700,000, and also the wires of the electric light and telephone companies. No doubt this new departure on the part of the assessment commissioner of Toronto will be the means of carrying the question of the liability of the gas and electric corporations to assessment in this manner into the courts for decision, and the outcome will be looked for with much interest by similar companies in other localities.

ELECTRICAL SHOP EQUIPMENTS.

THE subject of separate motors for machine tools which are directly connected to the moving parts of a machine is coming forward as an important element in manufacturing establishments, and although a comparatively recent innovation it promises to play an important part in the economy of operation of the workshop.

We learn from *Electricity* that some interesting data on this subject was given in a paper read before the *Electrotechnische Verein* by Mr. Richter, chief engineer of Siemens & Halske's works.

The subject was considered under three different heads :

1. The factory is driven by an electromotor in the same way as by a steam engine, a turbine, or other motor ; in other words, the electromotor takes the place of the steam engine, etc.
2. The factory is divided into several groups, each of which is driven by an electromotor ; so called group working.
3. Each work machine receives its own electromotor ; so-called separate or single working.

As an example of the first method may be mentioned a spinning mill at St Blasien, in the Black Forest, which is driven by turbines, and where the water that has driven these turbines is utilized again, about one kilometre below the factory, by another turbine installation, and the 200 horse power obtained there is transformed into electrical energy and transmitted back to the factory to yield 150 horse power to the main shaft.

The same mode of working also occurs in factories consisting of separate buildings at some distance from one another, and where electromotor working, compared with steam working, will be found economical. Mr. Richter mentions an example of this from his own experience.

It was a question of replacing in a sugar refinery a 35 horse power steam engine, placed in a distant building, by an electromotor to be supplied with current from an electric central station working at a high efficiency, while the steam-engine received its steam from the same boiler plant.

The steam dynamos of the central station consume 7 kg. of steam per effective horse power per hour. At an efficiency of only 90 per cent. for the steam dynamos, of 95 per cent. for the line, and of 90 per cent. for the 35 horse power electromotor, we find a total efficiency of 77 per cent., which means that in the central station 9·1 kg. of steam per hour would have to be expended for each effective horse power produced in the distant building.

The steam consumption of the 35 horse power steam engine amounted at least to 17 kg. per horse power hour, and was, in fact inclusive of the loss in the long pipes, 20 kg. A saving of 54 per cent. was thus effected by electric working.

As an example of group working Messrs. Siemens & Halske's Charlottenburg factory may be mentioned. The arc lamp factory, opened in 1890, is provided in each of its six rooms with an electromotor driving a short transmission shaft with two safety couplings. From these two electric couplings two shafts running the length of the room are driven, and from these latter, by means of an intermediate gearing fastened to the ceiling, are driven the tool machines. Thus every room is independent of the others, and is besides by the safety coupling divided into two parts independent of each other, so that if from any reason the work has to be interrupted in one place this derangement need only extend to half the room.

There is yet another advantage attached to this arrangement and that is that all the transmissions from one room to another are avoided, and consequently also those dangers caused by the openings in the ceilings made for belt transmission, and which have often contributed to the spreading of fire. And, further, the main transmissions, which are a source of great loss of power, are avoided by group working.

After the favorable results obtained by group working, the 100 horse power steam engine installed in the oldest portion of the Charlottenburg works has been put out of operation, the various sections of the transmission have been divided into five groups, and each group has been driven by an electromotor of proper size. The working current was supplied from the electric station, which is fitted with a highly efficient boiler and machinery plant.

In addition to the saving of energy by suppression of the main transmissions, this arrangement has also the advantage that for night work of individual tool machines the whole transmission need not be run, but only a special portion of a certain section.

Mr. Hartmann, of the firm of Hartmann & Braun, Bockenhiem, who has made similar tests, found that the losses of energy caused by transmissions were by no means so small as is generally supposed. He ascertained that a triple transmission had an efficiency of from 13·7 to 66 per cent., or a mean of 47 per cent., and a double transmission of from 52·1 to 71 per cent., or a mean efficiency of 64 per cent., according to the size and extent of the transmission. The numerous investigations made by Messrs Siemens Halske have given similar results In triple transmissions an efficiency of less than 50 per cent. has repeatedly been found, and in double transmissions the mean of many observations was found to be 56·6 per cent. The results, however, are entirely different in installations where all the machines are not always in operation, a condition which obtains in most of the factories. In several of the workshops of the Charlottenburg works Mr. Richter has for some time kept a careful record of the actual working hours of the tool machines, and has found that these hours amounted to from 47 to 74 per cent., or a mean of 62 per cent. of the whole working time. The mean efficiency of a triple transmission is hereby reduced to 29 per cent., and that of a triple transmission to 40 per cent.

Now, as regards electric group working, it will be clear that by arranging the tool machines in smaller groups, so that the intervals of work always affect a whole group, this running without a load can be avoided. If, further, the installation is made in such a way that a double transmission can be dispensed with, a considerable advantage, from a commercial point of view, will be obtained by electric working.

Assuming 90 per cent. to be the efficiency of the generator, 95 per cent. that of the line, and 85 per cent. that of the electromotor (all these values are taken rather low), we get a total efficiency of 72½ per cent., as against 64 per cent. or 40 per cent. for double transmission.

To distribute the machines in such a way that all the machines of the same group are always simultaneously at work will be found difficult because it must naturally tend to making the groups smaller and smaller and thus lead to single motor working. At first sight it may seem strange to provide each tool machine with its own electromotor. The objections against such an arrangement are that it renders the installation too expensive, and that on account of the low efficiency of small motors such a system is not economical. Both these contentions are true to a certain extent. As regards, first of all, the prime cost, Mr. Richter has made a large number of calculations, and has found, for instance, that in one of the rooms of the arc lamp factory, where, as has been mentioned, group working has been adopted, and which contains 42 tool machines driven by a 25 horse power electromotor, the prime cost would only have been 13 per cent. dearer if, instead of the one electromotor with transmissions and belts, 42 electromotors with their accessories had been employed. In another room containing 29 tool machines. driven by an 8 horse power electromotor, the result would have been even more favorable, so that a mean of 10 per cent. may be assumed. It must, however, be pointed out that this 10 per cent. only refers to the prime cost of the motor installation and not to the cost of the tool machines, so that on comparing the total cost of single working with that of group working of the whole installation the additional expenditure would hardly amount to more than 3 or 4 per cent.

Now, as regards the efficiency, we will at once assume the most unfavorable case. An electromotor of ¼ horse power, the smallest to be used for similar purposes, has an efficiency of 70 per cent.; taking the efficiency of the line at 90 per cent., and that of the generator also at 90 per cent., we get a total efficiency of 57 per cent. Supposing, further, the tool machine to be joined to the motor by an intermediary piece absorbing 10 per cent., we get a total efficiency of over 51 per cent. Comparing this with the 40 per cent. efficiency of a double transmission it will be seen that the result is not nearly so bad as might be expected. It is clear that in a factory where the working hours of the tool machines exceed 62 per cent. of the total working time the result would be more unfavorable, but even in this case the efficiency would only be inferior to a double transmission if the above percentage amounted to 80 per cent. In basing our calculation, not on the smallest, but on motors of average size, for instance of one horse power, we find that the above figure of 57 rises to 61 per cent., and that of 51 to 55 per cent.; assuming the working hours of the tool machines to be 81 per cent. of the total working time, the efficiency of single motor working will be found equal to that of a double transmission. Compared with group working which, on account of the larger motors employed, has a higher efficiency than single motor working in proportion of 9.8, we may say that single working with motors of one horse power mean capacity, assuming the working hours of the tool machine to be 75 per cent. of the total working time, gives the same efficiency as group working where the whole of the machines of one group are either working or standing still at the same time.

Single motor working presents special advantages which will, in many cases, compensate for the higher prime cost. In the first place, by combining the motor with the tool machine, the belts, which so greatly obstruct the light, are dispensed with; the appearance of the room and the light are improved and the existing space can be utilized for the erection of galleries. The building, not having to support transmissions, can be of lighter construction; the tool machines can easily be shifted for certain work, requiring only an alteration of the electric wires; the cost of maintenance is diminished by the absence of long belts, and finally a complete independence of the various tool machines is obtained, so that for working after hours or during the dinner hour any one of the machines can be operated without being obliged to run a transmission consuming much power.

TURBINE EFFICIENCY.

EXPERIENCE has proved says C. R. Tompkins in *Milling*, that to obtain the best results with any turbine wheel, the supply must be equal to the capacity of the wheel. For example, a wheel of good modern construction that has the capacity for using one thousand cubic feet of water per minute under a given head will return in useful effect from 80 to 85 per cent. But if the supply to the same wheel were cut down to one-half quantity or five hundred cubic feet under the same head, it is very doubtful whether more than from 40 to 45 per cent. of useful effect would be realized. There is also another important point to be taken into consideration by those who are about to purchase a new wheel, that those wheels which have been tested and show a high percentage of power in the testing flume whether it be at Holyoke or at any other place, are always tested at their best and under the most favorable conditions and with full water. But this is not always a safe criterion, for how many wheels are there in daily use that are ever run strictly with full water. There must always be a surplus to regulate the speed by, otherwise the speed could never be uniform or depended upon for regularity and the probablities are that a large majority of wheels are running most of the time upon three-quarters to seven-eighths water.

The term water instead of gate is used for the reason that the term half-gate or three-quarters gate does not always convey a correct idea of the amount of water used by the average turbine. Therefore the amount of gate opening is no safe criterion in estimating the quantity of water used, for most of the wheels at the present time are so constructed that the combined gate-openings represent an area nearly, if not quite, double that of the combine openings in the wheel, so that half-gate may really mean three-quarters, seven-eights or nearly full water. Now in order to show that this is not exaggerated, take the following, which is quoted from the catalogue of one of the prominent manufacturers of turbine wheels at partial gate and this may be taken as a fair sample for most others. The catalogue says "with full gate, using 2,751.80 cubic feet of water, .867 per cent. of useful effect was returned. With half gate, using 1,996 cubic feet of water, the percentage of useful effect was .654 per cent. With three-eights gate, using 1,621 cubic feet of water, .581 per cent. was returned." Now it requires but little figuring to show that in this case one-half gate discharges within less than sixty-eight cubic feet of three-quarters the capacity of the wheel at full gate, so that in this case half-gate really means three-quarters water. Again at three-eights gate, the quantity of water discharged being 1,621 cubic feet, does not by any means represent three-eights of the full supply, for $\frac{3}{8} \times 2751.87 = 1031.95$ cubic feet which is 590 cubic feet in excess of that amount, for if the gate openings had been in proportion to those of the wheel, that is to say, only sufficiently larger to compensate for the friction of the water in passing through them, then at three-eights gate it should have used 1,031.95 cubic feet of water instead of 1,621, while at half gate it should have used 1,375.93 cubic feet instead of 1,996. Again if we take the same average percentage of power from the quantity of water used and apply it to the quantity of water that should have been used provided the gates openings were in proper proportion to the wheel, the percentage of power at half-gate would have been 40 per cent. instead of 66, and three-eighths gate would have fallen off in the same proportion, and probably less than 30 per cent. of useful effect would have been realized. In another wheel of different manufacture, the published test showed the greatest efficiency at a point about half way between three-quarters and seven-eights gate and from seven-eights to full gate the percentage of useful effect fell off about 10 per cent. Now there must certainly be something wrong in the construction of that wheel, otherwise if the gate openings were in proper proportion to the wheel the efficiency should gradually increase as the gate openings increased and the greatest efficiency should be at full gate. Now the probabilities are that the relative size of the gate openings were such that when it arrived at seven-eighths gate the wheel had all the water it could discharge and a further supply acted as a detriment to it rather than an advantage and in this case seven-eighths gate really was full gate or full water. If any one can explain this upon any other hypothesis we should be glad to hear it. The makers of the wheel, however, claim that as one of the peculiar advantages possessed by their wheel, viz., its greater efficiency at part gate, but the probabilities are if they should stop at seven eighths of the gate opening and call it full water and then figure back upon the same principle, or, in other words, drop the gate opening entirely and figure strictly upon the actual amotut of water discharged, that is to say call one-half the water discharged one-half gate, three-quarters water three-quarters gate, and so on, the chances are that those same wheels as well as many others that have shown such remarkably high tests in the testing flume based upon the gate opening, when tested strictly upon the quantity of water discharged under those conditions, those remarkable results that are claimed upon half gate tests would fall off materially and they would fall into line with many others that make no such pretensions or have never seen the inside of a testing flume, either at Holyoke or any other locality, aside from the mills where they are in use.

HOW TO FIGURE ON LIGHTING A GIVEN SPACE.

IN answer to an enquiry of a correspondent, the *Architects Electrical Bulletin*, gives the following:

The number of incandescent lamps required to illuminate a given space is arrived at from a computation of the square feet of flooring, allowing one lamp to so many square feet, according to the kind of illumination required.

On this plan it is presupposed that chandeliers are employed, and not ceiling work. Chandeliers should depend from the ceiling uniformly at a distance of about seven and one half feet from the floor in order to get the best results. At this distance it is correct to allow one 16 c. p. lamp to forty square feet for excellent lighting; for good lighting it is customary to allow one 16 c. p. lamp to sixty-four square feet, and for general illumination, one 16 c. p. lamp to one hundred square feet of floor.

In ceiling work which is becoming more and more popular where expense is not considered, lamps may be used ad libitum. In this kind of work no rules can be observed, as height of ceiling, color of decorations, effect intended, and many other things may be taken into account by the artist.

The candle power of arc lights is so variable that their use is limited to big spaces, and the best result from any given light is simply a matter of experiment, and cannot be arrived at by any rules at all. In regard to the cost of the installation of the Interior Conduit system, including wire and labor, it is safe to say that a fair average is $3 a lamp. This does not include fixtures.

A company is being formed at Kalso for the purpose of lighting the streets of Kalso, B. C., by electricity.

SPARKS.

The new electric railway at Peterboro is now in readiness to go into operation.

The construction of the new Electric Street Railway at Kingston, Ont., has been commenced.

The receipts of the Toronto City and Suburban Railway are said to average over $1,200 per week.

It is said that the Reliance Electric Manufacturing Company will shortly install a lighting plant at Tilbury Centre, Ont.

The Ball Electric Light Company, London, Ont., are putting in a large drain to carry water from the river to their works.

The Port Dalhousie, St. Catharines and Thorold Railway Company has been incorporated with a capital stock of $100,000.

The Ball Electric Light Company, of London, have secured the contract for lighting the grounds and buildings of the Western Fair.

The Toronto Street Railway Company propose to extend the Toronto Mimico road, which they purchased recently, to Long Branch.

The construction of an electric railway is under contemplation at South Edmonton, N. W. T. The cost would be about $100,000.

On the first of July, the new incandescent plant lately purchased by the Renfrew Electric Light Company was successfully put in operation.

The St. Jean Baptiste Electric Light Company of Montreal, have lately installed a new alternating electric light dynamo, at a cost of $5,000.

The London Street Railway Company are laying the rails on the extension of the Dundas street line. The Baker rails are used, being 35 feet long.

The City Council of Port Arthur, after a lengthy discussion, decided at a recent meeting to purchase the electric light plant, the price to be settled by arbitration.

The Carter Motor Company, of Stratford, has been incorporated with a capital stock of $300,000 to manufacture the Carter motor and the Carter rotary engine.

The operation of the Toronto and Scarboro Electric Railway was commenced on the 1st of July. Everything worked satisfactorily and the road was well patronized.

The municipality of Cote St. Louis has granted a 30 years franchise for an electric railway to the Montreal Street Railway Co. The construction of the road will commence immediately.

Geo. H. Campbell, manager of the Winnipeg Electric Street Railway Company, has purchased a number of new cars. He says that extensive additions to the line will be made at an early date.

Mr. Wm. Kennedy, hydraulic engineer, of Montreal, is investigating at Port Arthur the feasibility of using the Current river power for the operation of an electric street railway and a lighting plant.

Mr. J. J. Myles, of the Hamilton, Grimsby and Beamsville Railway Company, states that work will be commenced on the road at once, and that it will be completed to Grimsby by next winter.

The proposition has been made at Ottawa that steps be taken to decide the capacity of the Chaudiere and Rideau Falls. It is said that at present an undue share of the power is monopolized by a few firms.

Messrs. McRae & Company, of Ottawa, are now operating Messrs. Allan & Fleming's Wakefield mica mines. They have 30 employees, and use steam power. The mica is prepared for the market at Ottawa.

On the recommendation of Mr. Collingwood Schrieber, Government Engineer, arrangements are being made to put in an electric plant with which to open and close the locks of the Sault Ste. Marie canal.

Owing to the trouble that has been experienced by the Toronto Street Railway with the Edison motors heretofore in use, the manager has decided to replace them with Westinghouse motors, at a cost of about $50,000.

An agitation is on foot at Moncton, N. B., for the construction of an electric street railway. It is proposed to construct a belt line, with double track, 3 miles in extent, and equip with 6 cars, at an expenditure of $75,000.

Owing to the death of Mr. John A. Wills, the inspection of the boilers and machinery of the various government institutions, has devolved upon Mr. A. M. Wickens, chief engineer at the new Parliament Buildings, Toronto.

It is said that Mr. Van Horne, President of the C. P. R., contemplates using electricity for the purpose of drawing trains up the Kicking Horse Canyon. It is proposed to procure the necessary power from the Kicking Horse River.

The Dominion Government has granted a subsidy of $2,100 towards the construction of a telephone system from Lethbridge to Lee Junction, N.W. T., a distance of 28 miles. The Mormons in the locality have also contributed to the undertaking.

On the evening of the 10th of July, George Lanthier, a dynamo attendant in the employ of the Royal Electric Company, of Montreal, was caught by the machinery and instantly killed, his body being terribly mangled. There was no one present when the accident occurred.

Electricity is now used in traction, in illumination, in telegraphy, submarine and terrene, in engineering, medicine and surgey, in agriculture, horticulture and floriculture, in many kinds of mechanism in manufacturing, in heating, in cooking, and in yet other service. There are thousands of miles of electric railway; a new electric ship is nearly completed at one of our Pacific ports; and we have a promise of a new kind of electrical balloon.—*Electric Power.*

Mr. W. J. Gilmour, of Brockville, district manager of the Bell Telephone Company, has been making arrangements to improving the telephone service at Renfrew. About 20 additional telephones will be put in, and a long distance communication and an all night service furnished.

The shareholders of the Ottawa Electric Railway and the Ottawa City Passenger Railway Company have been informed that there has been reserved for them $12,000 of the stock of the new Ottawa Car Company. The capital stock is $50,000, only $25,000 of which will be issued at present.

The Railway Car Heating and Ventilation Company are seeking incorporation with a capital stock of $1,000,000. The directors are Wm. McKenzie, J. C. Close and H. A. Everett, of the Toronto Street Railway Company, and Major S. Hughes, M.P., of Lindsay, the latter being the inventor of the system.

The electric railway between Vancouver and New Westminster, B. C., is the longest straight line in Canada. It passes through the primeval forest, and the scenery along the road is said to be of the loveliest description. The road is said to be thoroughly equipped, and the possibility of accidents reduced to a minimum.

As soon as the City Councils of St. Stephen and Milltown, N. B. shall have located the line, the electric railway company will proceed with the building of the road. It has not been definitely decided what action will be taken by the citizens of St. Stephen, but it is stated that in any case the road will be built in Calais.

Sunday cars is the all-absorbing topic in Toronto at present. A vote of the citizens on the 26th inst. will decide for the present whether or not the cars shall be allowed to run on Sundays. Should the majority vote yea, the profits of the Street Railway Company will be increased by many thousands of dollars.

The City Council of Belleville has granted the request of Messrs. Close and Fraser, of Toronto, for an extension of time in which to commence the construction of the proposed Belleville Electric Street Railway, on condition that a deposit of $1,000 be made with the City Treasurer, to be forfeited if the agreement be not carried out.

A person named O'Connor recently sued the Nova Scotia Telephone Company for having, as he alleged, mutilated his trees while stringing wires. The case was carried through the various courts and reached the Supreme Court at Ottawa a week or two ago, where the decision of the inferior courts in favor of O'Connor was reversed.

The Kingston Street Railway Company have purchased the water power and buildings at Kingston Mills. During six months of the year, when the canal is closed, there is obtainable 1,000 horse power; and during the balance of the year, 300 horse power. It is proposed to use the power for the operation of the new electric street railway.

A petition has been presented to the Hamilton City Council, by the President of the Hamilton and Dundas Railway Company, asking for an amendment to the city by-law under which the road is chartered, so as to admit of the road being operated by electricity instead of steam. It is proposed to rebuild the road as a double track system.

At a meeting a few days ago of the Brass Manufacturers' Association, dissatisfaction was expressed with the difference in duties imposed by the tarift, on electric and gas fixtures. Electric fixtures bear a duty of 25 per cent., while gas fixtures are taxed 30 per cent. The Finance Minister has been communicated with on the subject, and has promised that the matter will be attended to.

The Council of the village of Markham propose to sell the electric light plant, which has been operated by the municipality. A local paper states that the Council have spent enough money in legal expenses to run the plant for a year or more, and that on several occasions the town has been left in darkness because of the failure of the Council to supply the necessary fuel to operate the plant.

The following gentlemen have been elected as the officers of the Sandwich, Windsor, and Amherstburg Electric Railway: Dr. Coventry, president; G. M. Hendrie, vice-president; W. S. Pulling, secretary-treasurer; with the following directors: W. Hendrie, R. Thomson, Hamilton; W. J. McKee, James Anderson and John Davis. Mr. James Anderson has been appointed manager of the electric light department.

The City Council of Vancouver, after having placed in the estimates $360,000 for the purchase of the street railway property, recently voted down a motion to submit a by-law to raise the necessary amount. It is now proposed that the city shall guarantee interest on $400,000 of debentures of the company, and allow the company to exist, but the city to have a controlling interest. It is not likely that this will receive the endorsation of the ratepayers. The Westminster and Vancouver Tramway Company have offered should the city secure the road, to lease the property from them, and pay interest on $400,000.

A sub-committee of the electric railway committee of the Montreal City Council has recommended that permission be granted to the Montreal Belt Line to construct a road from east to west through the City via St. Catharine, Delorimier, Craig and St. James Streets, the Company to pay $2,000 per mile to the City, and be responsible for the damages. The committee also recommend that Robert Bickerdike be permitted to build and operate a line from Dominion Street along St. James Street to Little Craig Street and along Craig Street to the Champ de Mars, on payment of $1,200 per mile of the line for the first year, and $2,000 per mile subsequently. The road to extend west from the city limits a distance of 3 miles, passing through St. Cunegonde, St. Henri and Cote St. Paul.

MOONLIGHTS SCHEDULE FOR AUGUST.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1......	P. M. 7.50	P. M. 10.30	2.40
2......	" 7.50	" 10 50	3.00
3......	" 7.40	" 11.10	3.30
4......	" 7 40	" 11.40	4.00
5......	" 7.40	A. M. 12.20	4.40
6......	" 7.40	" 1.00	6.20
7......	" 7.40	" 1.10	5.30
8	" 7.40	" 2.00	6.20
9......	" 7.30	" 3.10	7.40
10......	" 7.30	" 4.10	8.40
11......	" 7.30	" 4.10	8.40
12......	" 7.30	" 4.10	8.40
13......	" 7.30	" 4.10	8.40
14......	" 7.40	" 4.10	8.30
15......	" 8.00	" 4.10	8.10
16......	" 8.20	" 4.10	7.50
17......	" 8.50	" 41.0	7.20
18......	" 9.10	" 41.0	7.00
19......	" 9.50	" 4.20	6.30
20	" 10.20	" 4.20	6.00
21......	" 11.00	" 4.20	5.20
22......	" 11.20	....	.....
23......	....	" 4.20	5.00
24......	A. M. 12.20	" 4.20	4.00
25	" 1.20	" 4.20	3.00
26......	" 2.40	" 4.20	1.40
27......	No light.	No light.	....
28......	No light.	No light.	....
29......	No light.	No light.	....
30......	P. M. 7.10	P. M. 9.20	2.10
31......	" 7.00	" 9.50	2.50
		Total,	153.40

THE ELECTROLYSIS OF WATER PIPES.*

By C. H. Morse.

WHEN electric cars were first put in operation in Cambridge (Mass.) they depended upon mother earth, the water pipes, the gas pipes, and anything over which the current could flow, to convey it to the station or act as a sewer. No thought was given to the loss which would result to the Company from doing this, to say nothing about the effect upon pipes. I can, perhaps, illustrate this loss by saying that three months ago, in parts of Cambridge, the loss of pressure due to the power which was required to force this current back over this uncertain path was 20 per cent.

When the railroad company put in their power plant, they run large numbers of feeders and one wire between the rails, and attached the two rails to this return wire. This became very soon an uncertain path, as it was found that electrolytic action took place upon this wire and it disappeared in places. They thought at first that it was due to something in the soil, but it was very soon traced to the enemy, that is, electrolytic action. I remember the practical experience we had with these dead rails, as we call them. When this wire was eaten off and a car came on to that section, if by any chance you placed one foot upon the rail and another upon the ground near it, shocks could be obtained.

Mr. Nevons and I went to the different places where we had traced these difficulties, or where they had been called to our attention rather, and found that lead pipes had disappeared in a short space of time, some even in six or eight weeks. Iron pipes had been tried with the same result, also galvanized iron ; brass pipe had been put in, and deterioration was noticed at once. Rustless iron was tried, and it did rust decidedly. It was not the work of any mysterious agent, but was the result of what almost all of you have seen in school experiments, that is, the decomposition of water. A speedy remedy for that, of course, was easily apparent, that was to reverse the current. So the officials of the West End Railroad Company were invited to a conference with the Water Board and myself, and I am pleased to say the Company were willing and anxious to do anything in their power to obviate this difficulty. A certain amount of credit belongs to them for that, although, of course, they had themselves a reason for wanting to do it. They were losing anywhere from 5 to 20 per cent. of their power in this return.

Observations were made by several of the waterworks employes unintentionally. Such an immense amount of current was flowing over the pipes that upon attempting to make a joint by putting oakum around the pipe, it was found that the electric arc was sufficient to set fire to the oakum, frightening the men considerably. Tests were made in different parts of the city by means of instruments adapted for the purpose, and we found between North Cambridge, Harvard Square, Central Square, and East Cambridge a fall of potential all the way from 25 to 45 volts. Now, there should be no fall of potential, but there was a loss of from 25 to 45 volts, from 500 volts, which is the maximum pressure, making more loss than can be allowed with economy. When we attached to the negative pole of the machine and made our tests from Harvard Square, we found a loss of 100 volts, or 20 per cent. of the pressure. You can now see, as I said before, why the Company was very ready to take hold of this matter.

How are we to remedy the difficulty ? I know of no way by which we can use the single trolley wire system and overcome this difficulty without putting up an immense amount of overhead returns, through which the resistance willl be reduced to almost nothing. How far the Company will be willing to go in this I cannot say. Their spirit has been so admirable in the past I have no right to suppose but what they are willing to carry it to that extent. Certainly, the city will require it carried to such an extent that the pipes will be in perfect safety. The maximum amount of current which can be allowed to go over them I am unable to tell you at present, but a series of experiments are being conducted now at my house to determine this. I have some pipes buried in the earth, the current flowing over them, and I am watching carefully the deterioration daily. I am in hopes to make a report soon to the Water Board upon the maximum amount which can be allowed to flow upon iron pipes.

By doing what we did, reversing the current and attaching our water pipes to the negative pole of the dynamo, we hurt one of our old friends seriously, that is, the Gas Company. You see the effect. The current will flow on the water pipes, and it has an easy chance to leave them through their connection with the negative pole of the dynamo. Now it flows along on a gas pipe and as soon as it can it will leave the gas pipe to take to the water pipe. I felt it my duty to make this clear to the President of the Gas Company, and called his attention to it, saying that something ought to be done to protect him, and a conference was had between the railroad people and the Gas Campany, and I was invited to be present. At that time we made an arrangement with the Company which will help it somewhat in that direction, and help us as well as them. We propose now to connect the gas pipes and the water pipes together in all parts of the city. It will be done in buildings. A man from the West End Company has been appointed who goes as a gas man to the different stores and factories, and in those places he will solder a wire to the gas pipe and also to the water pipe. This can do no injury to either, but will decidedy help both companies.

I was somewhat surprised at the way they attempted at first to return the current. There are girder rails that have, we will say, 10 sq. in., some of them have as high as 14 sq. in., sectional area. That would have a carrying capacity equal to a piece of copper 2 in. square. And yet these rails are bonded by a No. 4 copper wire, a wire smaller than a lend pencil. It seems quite ridiculous that they should require this little bit of fine copper wire to carry as much current as a big rail, where they should have a piece of copper wire, as I said before, for these big rails, of at least 2 sq. in. sectional area. There is another remedy also which we hope to carry out early in the spring, and that is to abolish completely this return wire between the rails, by cutting it into sections of about 400 ft., and connect each of these sections with the return wires. Most of the current will then return by these copper wires. Of course, some of it will flow over the water pipes ; that cannot be helped as long as one side of the machine is connected with the earth. Another remedy which is to be adopted, is a special line of feeders attached only to the water pipes ; that is, a feeder will be run from the central power house to the different parts of the city, which will not be connected with the machines at all, but will be connected with the water pipes at the central power house and with the pipes in all sections of the city. This will also materially reduce the electrolytic action.

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*Abstract from a Paper read before the New England Waterworks Association.

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Correspondence is invited upon all topics coming legitimately within the scope of this journal.

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KINGSTON, ASSOCIATION STATIONARY ENGINEERS.—Meets twice each month over No. 1 Fire Station. J. Devlin, President: W. Gilmour, P. O. Box 699, Secretary.

WE gather from recent personal interviews with persons interested in electrical matters in the United States, that the line of action taken by the General Electric Co. towards manufacturers of incandescent electric lamps, is regarded as a huge mistake. Most of the lamp manufacturers stood prepared to pay the General Electric Co. a fair royalty on the production of their factories if a liberal disposition had been shown towards them. The attempt to crush them out of existence has aroused the determination that by some means they will survive. The minds of inventors have been stimulated to produce lamps which could not be proved to infringe the Edison patents, and in many instances they have succeeded. This fact, as well as the decision in the case of the Columbian Lamp Co. and the brief period constituting the future life of the Edison patents, has resulted in the entire failure of the coersive policy of the General Electric Co., which is likely to find little comfort in the reflection that its treasurery is minus many thousands of dollars which, had its methods been more conciliatory, it might have enjoyed possession of.

THE apparently growing desire on the part of a certain proportion of Canadian engineers to improve their educational status is to us a graifying sign of the times. It means that in the future steam plants will be better cared for and more economically managed, that in consequence a higher value will be placed on the services of competent engineers, and that they will receive better remuneration. It should be the aim of every engineer who is ambitious to rise, to pass the examinations and obtain the certificate of the Canadian Association of Stationary Engineers. We desire that this journal should be of assistance to engineers who are seeking to qualify themselves to pass these examinations. With this purpose in view we have arranged with a gentleman who is a well known authority on steam engineering to contribute to the NEWS a series of articles which we have every reason to believe will be found helpful to those who propose to present themselves for examination. The first of these articles, under the title "Notes for Steam Engineers," will be found in the present issue, followed by others in succeeding numbers. We commend them to the careful attention and perusal of engineers, and shall be pleased if as many of our readers as feel interested would criticise and discuss through our columns the points raised.

THE electric car system has been roundly abused by the newspapers as a wholesale destroyer of human life. While unquestionably the danger of accident has to some extent been increased by the enhanced speed at which electric cars travel as compared with horse cars, it is nevetheless true that two-thirds at least of the persons who have been killed by the cars since their introduction into Canada, lost their lives through their own carelessness. If, as we have observed, people will cross the path of electric cars at a snail's pace, with their attention absorbed by every passing object, instead of being on the alert against a danger which they know exists, their injury is certain to follow in spite of all the care which can be exercised by those in charge of the cars. In this connection the fact should be stated that the bicycle has come to be a greater source of danger to pedestrians than the electric cars. The cars run only in the middle of the streets, and only upon certain streets; the bicyclist runs everywhere unless prevented by the law. The popularity of the bicycle is such that at certain hours the streets are literally filled with riders, male and female, travelling at every rate of speed from five to twenty miles an hour. A business man of Winnipeg while descending from an electric car a few days ago was struck by a bicycle and so seriously injured that he died shortly after. There is raason for the demand that the speed at which bicycles may be ridden on public thoroughfares should be limited bv law to five miles an hour.

ONE of the things which we have to deplore is the loss of a large number of our brightest and most ambitious young men, who for lack of opportunity of making the most of their talents and energy, migrate to the centres of population in the United States. It should be the aim of every patriotic Canadian to find openings for the employment of as many as possible of these young men in their native land, where they would assist to build up a great nation, such as we hope this Dominion will one day become. It is in the hope of retaining one such young Canadian that we publish the following extract from a letter received a few days ago from Lynn, Mass. :—" In about three weeks I shall have completed the expert course with the Thomson-Houston Electric Co., and when through would like to return to Canada. Having seen in your paper lately notices of quite a number of new electric roads being built, I thought you might know of some openings for an electrician. I have had altogether six years of practical experience in electricity. I do not want an office position with nothing to do, but a place where there is plenty of work, such as electrician for a street railway company or electrician of a lighting and power company in a town of good size." The writer of the above is possessed of the requisite training and energy to perform good service in a position such as he is seeking ; his letter is accompanied by excellent Canadian references, and we would be greatly pleased to place him in communication with persons in need of his services.

ONE of the essential things about an electric plant at this time of the year is means to protect it from damage by lightning. No station or power house is fully equipped until such means have been provided. Not only does this apply to the larger plants but to the small ones as well. It is just as necessary to protect a plant running a single dynamo as it is one operating many of them, and since there are efficient lightning arresters made for all classes of circuits it is almost inviting the destruction of the plant not to apply them. There is perhaps more need for them on a power plant than on any other, particularly one with a grounded circuit such as is used to operate street railways. In such case it becomes imperative that they be used. They should not only be placed inside the power house but at intervals along the line as well, and in places where the lightning discharges are usually of a severe character such intervals should be very short indeed if absolute protection is desired. On ordinary power circuits operating stationary motors there should be a lightning arrester with its ground wire well connected in every place where a motor is used, or very close to it, otherwise there will be a constant tendency to crippling of the motor from lightning discharge, particularly if such discharge occurs close to the place in which the motor is being used. A perforation of the shunt winding or armature then follows and repairs become necessary. This means an expenditure that would not have been necessary had there been a lightning arrester in use at or near the motor. It may appear to some that the discharge should take what would seem to be the easiest path to earth through the lightning arrester at the station, but if that station happens to be a mile away, the small volume of current that is carried by the wires at the enormous pressure will find its path to earth by way of the machine frame in preference to travelling back that mile to find it. This, of course, would not be if the voltage was not high. To successfully protect your plant from lightning discharges, be it arc, incandescent, or for the supply of current for power purposes, you must use a good arrester and plenty of them.

A FEW days ago we were invited to accompany a party of representatives of the press, who, through the courtesy of the management of the Niagara Falls Park and River Railway, were given the pleasure of a trip across the lake and a ride on their new electric cars up and down by the cataract and its rapids, above and below, with opportunities of stopping off and viewing from all standpoints the attractions of nature there presented, and were entertained most hospitably, so that we carried away a kindly remembrance with the inspiration imparted by the majesty and beauty and the untiring activity and giant power displayed in this fascinating region. Elsewhere in this issue is given an account of the electric road as an engineering accomplishment. It is neat and sightly throughout and thoroughly and efficiently built and equipped, and the company are sparing no pains or expense which may further add to the safety, accommodation or pleasure of their passengers. Their safety is especially looked after by placing guard rails and rail braces on curves to prevent cars going off the tracks, or getting away if they should go off along the precipitous banks which they skirt. Besides this the wheels and trucks are extra heavy and the speed is moderated at these curves. Part of the way down the long grade at Queenston a siding has been made, which remains always closed, so that if by any chance a car should get away, or if the brake and reversing the motor should fail to work, it would run upon this, and so prevent a runaway down the Heights, with its consequences. Most people are familiar with the sights about Niagara, but none have seen them to as great an advantage with as great convenience and at as little expense as the passengers on this road now do. Starting with the historic scenes about Queenston and the Heights, the remains of the old suspension bridge and the fine view out towards Lake Ontario over the quieter portion of the river, we pass through a panorama of rapids and ravines, the whirlpool and its rapids, of bridges and glassy though swift water beneath with foam from the Falls; the Falls and the rapids and islands above ; till we stop in the quiet of Chippewa—twelve miles, which seem one, so much is our attention occupied. To those within reach of it, and especially to the people of Toronto, when taken in connection with the sail across the lake, this trip will no doubt prove the most attractive to those desiring a day's recreation of all the many attractive excursions that are to be had hereabouts.

LUBRICATING oils for use on electrical machinery are now in such steady demand that oil manufacturers are vieing with one another in attempting to turn out something better than has been supplied heretofore. This leads us to remark that the bad working of a dynamo can often be traced to a non-suitable lubricating oil, not necessarily a bad oil, but one that might be good for other uses. If there is any piece of machinery that requires a distinctive oil for use on its bearings it surely is a dynamo, the only suitable oil for which is a purely mineral one, not one containing as oils frequently do an animal or vegetable admixture. The use of oil of this character would make very little difference as far as the bearings themselves are concerned, but when it gets to the commutator, as it is bound to do, there is constant danger of the animal or vegetable part of it carbonizing or charring from the constant friction of the brushes and from the spark. This is liable to produce a short circuiting of some of the segments and make the machine so much less efficient, to say nothing of the damage it may cause if continued until a deposit of such charred oil settles itself into all the small cavities that are frequently found in the mica insulations, particularly after the commutator has been to some extent worn That such an oil will charr there is not a particle of doubt, and that it might be the cause of internal trouble in the armature itself we feel sure is a fact ; that it can find its way into the general run of armatures by being splashed or sucked in from the vicinity of the shaft is also true. If this thin layer of oil is subjected daily to a temperature such as is usually found in a well loaded machine after a few hours run, it will eventually ozidize, then carbonize and become a conductor to a greater or less extent ; trouble is then bound to be the result. We are of the opinion that this will be found to be the cause of fully one half the armature failures. We have positive knowledge that a large quantity of the oils bought for dynamo lubrication contain either lard or tallow oil as an admixture. This should not be, and the sooner oil men find this out the better it will be both for themselves and the users. We do not mean to say that oils containing these ingredients are not good lubricants, the reverse being decidedly the case, but they are out of place around a dynamo and should never be used. This applies equally as well to motors and generators. A motor grease for street railway use should be made entirely of mineral products, and should not possess any animal fats, such as lard, stearine or tallow. We believe that this is fast being recognized as a fact by the makers of such greases. It will only be a matter of a very short time before oils or greases containing these animal or vegetable admixtures will be entirely tabooed by users of electrical apparatus.

WE have several times referred to the extensive deposits of mica existing in different parts of Canada, and to the fact that these would likely prove of great value on account of the rarity of the material in other countries. Large investments in mica mines in Canada have lately been made, based on this belief, and upon the growing demand for the material from Europe and America. It is a matter of regret therefore, to be told by one of the largest buyers of mica for the British Admiralty and other concerns, who has lately returned from the World's Fair, that the mica exhibits from Bombay, Calcutta, and Australia, are greatly superior to those of Canada, and that if specimens of such size and quality as are to be seen at Chicago can be supplied from the places mentioned, they will rapidly command the markets of the world. Owners of Canadian mica mines state that the Canadian exhibit at Chicago does not fairly represent the Canadian mica industry, and that this is due to the lack of encouragement on the part of the Government in the way of free transportation, etc.

NOTES FOR STEAM ENGINEERS.

The tendency to-day is towards the use of higher pressure. Not very many years ago one of the fittings required on steam boilers was a valve opening inwards, so that when steam went down this valve would open and admit air and so prevent the boiler from being injured by a vacuum forming inside. The construction was such that internal pressure of a few pounds per square inch could be safely carried, yet the pressure of the atmosphere applied externally was sufficient to put the boiler out of shape. Steam boilers as made now do not need this form of safety valve.

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As higher pressures are used more intelligence and greater ability are called for in the men who undertake to manage steam boilers. The notion that anybody who can stir a fire is good enough to manage a steam boiler is almost as effectually exploded as were some of the old style boilers in which steam of a lifting pressure was raised by the fire stirring attendants.

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The man who takes charge of a steam boiler should make himself acquainted with it. He should measure it, and examine it both externally and internally, and know what it is he is going to raise steam in. He should know what pressure might with safety be carried and at what pressure the safety valve can prevent the pressure from increasing after it does open. He should also examine the furnace and flues and chimney and find out how he can regulate or control the chimney draught. He should see for himself where the water supply is obtained and judge of its being sufficient or otherwise. The pumps and valves, or injector and connections, used for putting water into the boiler ought to be tested. It is too late to discover that the pump will not work, after steam is up and the boiler is needing more water.

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The water gauges are often at fault, sometimes from dirt in the connecting pipes and frequently from carelessness in putting them up. The careful man will find out for himself the exact position of the water as shown by the gauges, and the top of the tubes, or other heating surface which must be kept covered with water. If the boiler is a horizontal tubular one with water gauges at the front end, he will try whether or not the boiler is level, as it may be down at the front enough to injure the tubes at the back end unless by carrying the water higher than is necessary to cover them at the front end. Having made sure that the water supply is all right and that water can be put into the boiler when steam is on, and that he can tell just how high the water really is, he will next see how it can be got out if need be. The blow off cock should be dissected. Some blow-off cocks are made to sell and many a fire stirrer has been sold by them. If the blow-off cock cannot be safely opened and shut again with steam on in the boiler, then either the boiler should stay without steam or the cock be removed to safer quarters, and a better one put on.

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The steam gauge which is intended to show the amount of pressure raised in the boiler should be tested and compared with a proper standard. It should either be correct or its amount of error known. The connecting pipe from boiler to steam gauge should be examined, as sometimes the pipe becomes choked with dirt and the pressure does not reach the gauge. The steam shut off valve and steam pipe becomes choked with dirt and the pressure does not reach the gauge. The steam shut off valve and steam pipe should be tried so that the engineer will know that the valve is actually on the spindle —that it fits its seat, and can be opened or closed by turning the wheel.

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When the man who is to take charge of a boiler has gone over all the points mentioned his next business would be to get up steam. There are some men who still seem to think that it is a sign of smartness and ability to get up steam with as little loss of time as possible and they will make a boast of the number of minutes it took to get 60 lbs. pressure from cold water. The careful man of experience will, however, rather take as long as possible to get up steam, especially if it is a new boiler, with new brickwork about it. The great consideration should be to heat the boiler as uniformly as possible, in order to avoid having it strained by unequal expansion. After the water is hot and there is some steam pressure on, the fire may be made brighter and the process hastened a little. All sudden changes, either from a lower to a higher pressure, or from a higher to a lower, should be carefully avoided.

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The duty of the man in charge may be summed up as consisting in keeping up steam with safety to boiler and all its fittings and with the most economical use of fuel. The motto should be safety first, economy second, and faithful diligence and cleanliness all the time.

CANADIAN ELECTRICAL ASSOCIATION

PARTICULARS REGARDING THE SECOND ANNUAL CONVENTION.—AN INTERESTING PROGRAM.

AS the present number of the ELECTRICAL NEWS goes to press, a meeting of the Executive Committee of the Canadian Electrical Association is being held in Toronto, to formulate the program and advance the arrangements for the second annual convention. While we are not in a position to print the program of proceedings, we are able to outline to some extent the character which it will probably assume.

The Executive, at a meeting held a couple of months ago, decided that the convention should be held on the Toronto Industrial Exhibition grounds on Tuesday and Wednesday, the 13th and 14th of September, during the second week of the Exhibition. Subsequent events indicate that the proceedings of the convention will occupy Thursday also. In our last issue it was stated that half a dozen papers on as many different subjects, and relating to the various departments of electrical work, had been promised. These will include a paper by Mr. E. Carl Breithaupt, of Berlin, Ont., on "Electric Street Railways"; a paper by Mr. A. C. McCallum, of Peterboro', on "Water Wheels"; a paper by Mr. E. B. Merrill, Toronto, on "Electrical Education"; a paper by Mr. L. B. McFarlane, Montreal, on "The History of the Telephone in Canada;" also papers by Messrs. Fred C. Robertson, of the C. P. R. Telegraph Co., and John Langton Toronto, the exact titles of which we are at present unable to state. The authors are now at work on these papers, manuscript of which it is hoped will be in the hands of the Secretary by the 20th of the present month, in order that printed copies of the papers may be obtained and forwarded to members of the Association for perusal prior to the convention. If this can be accomplished the discussion on the papers should be of a more intelligent and valuable character than it was possible for such discussion to be under the impromptu method which obtained at the two former conventions.

It is hoped that the authors of the papers will see the importance of completing them by the date mentioned, and that members will thoroughly digest them and come to the convention prepared to express their views thereon.

At the last convention, notwithstanding the disadvantage under which members were placed, by reason of not having had the opportunity of perusing the papers in advance, the discussions were a most interesting and valuable feature of the meetings. We doubt not that on this occasion they will be increasingly so.

In addition to the papers, there will be the addresses of the retiring and incoming presidents, together with reports of the year's transactions, consideration of required amendments to the constitution and by-laws, report of the Statistical Committee, which has succeeded in collecting a considerable amount of valuable data relative to the number and capacity of electric plants in Canada, and the conditions under which they are being operated. The need of statistics of this character has been felt on many occasions, and no doubt the committee's report will furnish valuable information as well as food for thought and discussion by members whose capital is embarked in the electrical business.

This being the annual convention, the members will be called on to select a competent staff of officers to manage the affairs of the Association for the succeeding twelve months. We need not enlarge upon the importance of this matter further than to say that every member who has the interest of the Association at heart should be present and assist to make the selection the best that could possibly be.

All that we have said thus far has related exclusively to the business features of the Convention. We fancy we hear more than one member soliloquize: "What about the social side of the Convention?" Ay, what indeed! Was there not a social side to both the former conventions? Those who were there, as well as those who read the reports of the proceedings, need no answer to this enquiry, knowing that on both occassions the sociability was pronounced and enjoyable.

At the approaching convention a rare opportunity is to be afforded the members of combining enjoyment with instruction. An invitation has been received from Mr. W. A. Grant, manager of the Niagara Falls Park and River Railway, to the delegates to the convention to take a trip over the line on Thursday, 15th Sept. In his invitation Mr. Grant says: "We will supply a special car for them, and will do everything in our power to add to the enjoyment of their trip." A description of this most interesting piece of electric railway construction appears elsewhere in the present number, and the opportunity which will be afforded of examining it in detail is one which no member of the Association should forego.

But this is not all. An invitation has likewise been extended to the delegates by the owners of the celebrated steamer "Maid of the Mist," to take a trip on the Niagara river and view the beauties of the cataract from on board the steamer, of which Capt. Carter, Superintendent of the Niagara Falls Electric Light and Power Co., is the well known commander. In this connection the following program has been suggested: Embark at Toronto on Niagara Navigation Company's steamer at seven o'clock a.m., landing at Queenston shortly after nine o'clock; trip of inspection over Niagara Falls Park and River Railroad from Queenston to Chippewa, then back to the power house at Table Rock; next under the Falls at Table Rock; back to New Bridge for lunch at Cliff House; shortly after two o'clock take the boat on Canadian side; cross to American side; go up elevator to Prospect Park; take electric cars to tunnel district; return to tower; next back by elevator to boat; boat by way of the Falls to Canada side; take cars for Queenston at 4.30, and at Queenston take steamer for return to Toronto.

We have no doubt that a program similar to the above will be adopted by the Executive Committee. We have to congratulate the members of the Association on the delightful prospect which awaits them. We learn that the Association will bear the bulk of the expense and that the cost of the trip to each member will not exceed one dollar. Under these circumstances, no one should fail to share in the enjoyment and instruction which the occasion will afford.

Too much cannot be said in praise of the generosity of the railway and steamboat companies in placing such a pleasant outing at the disposal of the Association. The Industrial Exhibition Association also, through their manager, Mr. H. J. Hill, have promised to assist in every way possible to enhance the interest of the meeting. It is also learned that several electrical manufacturing and supply firms have secured the necessary space and are making arrangements for an attractive exhibit of electrical appliances.

In addition to all this there is the Industrial Exhibition, which of itself attracts several hundred thousand visitors each year to the city.

Therefore, whether viewed from the standpoint of profit or pleasure, the second annual convention of the Canadian Electrical Association gives promise of being by far the best that has yet been held.

Persons interested in electricity who have not as yet connected themselves with the Association should send in their application for membership at once to the Secretary and take a part in the convention.

MUNICIPAL ELECTRIC LIGHTING.

The report of the Electric Light Department of New Westminster, B.C., for the past year shows that the municipal electric light plant has earned a considerable profit for the city during the last three months of the year. During this period, the receipts for lighting were $6,112, including $2,000 for street lights. The expenses for maintenance, etc., were $3,699 and for interest and sinking fund, $1,505, making a total of $5,204.

The station, which is under the management of Mr. P. Bowler, the city electrician, is conducted as if it were a private institution, and a charge is made to the various city departments for the lights furnished them. A general lighting business is carried on and lights are furnished the citizens, but at higher rates than those charged the city departments. These rates are, however, as low as it is possible to make them, and are as follows: 2,000 c.p. arc lights burning all night for public lighting, 25 cents a night; commercial lights burning till midnight, 50 cents; current for incandescent lights, by meter, one cent an hour for a 16 c. p. lamp; by contract, one dollar a month.

The station has a capacity of 2,115 incandescent lights, and 100 arc lights, current being furnished by Royal alternating and arc light dynamos. The steam plant consists of a 150 and a 180 h. p. Corliss engine and four 80 h. p. tubular boilers. The refuse from a large saw mill is used for fuel.

To meet the demand for lights, $15,000 has been voted to extend the station, and a 1,500 light alternator with new engine and boiler has been purchased.

PERSONALS.

Mr. L. E. Marple, of Chicago, has been appointed electrical engineer of the Montreal Park and Island Railroad Company.

Mr. J. Henry, formerly tool designer with the Canadian General Electric Company, Peterboro', has accepted a position in New York.

Mr. J. B. Griffith has been appointed to succeed his brother, the late T. B. Griffith, as manager of the Hamilton Street Railway Co.

Mr. John Albinson has been appointed chief engineer and electrician of the Hotel Vancouver and the C. P. R. Opera House at Vancouver, B.C.

G. H. Campbell, manager of the Winnipeg Electric Street Railway Co., paid a visit of inspection to the Toronto, Montreal and Ottawa railways, recently.

Mr. H. Woodman, who has been for a long time with the Royal Electric Co., has resigned his position with that company to accept one with the Montreal Street Railway Co. and is now in charge of the power house of the latter company.

Mr. Lewis Burran has severed his connection with the Royal Electric Co. and accepted the position of electrical engineer of the Montmorency Electric Power Co., of Quebec. Mr. Burran has had an extensive practical experience in electrical matters and is very well qualified for the position he is to fill.

Mr. John Inglis has been appointed successor to the late John A. Wills, as chairman of the Toronto Technical School Board. Alderman John Bailey has been appointed vice-chairman. At the meeting at which these appointments were made, several of the members expressed a sence of their deep regret at the sudden death of Mr. Wills.

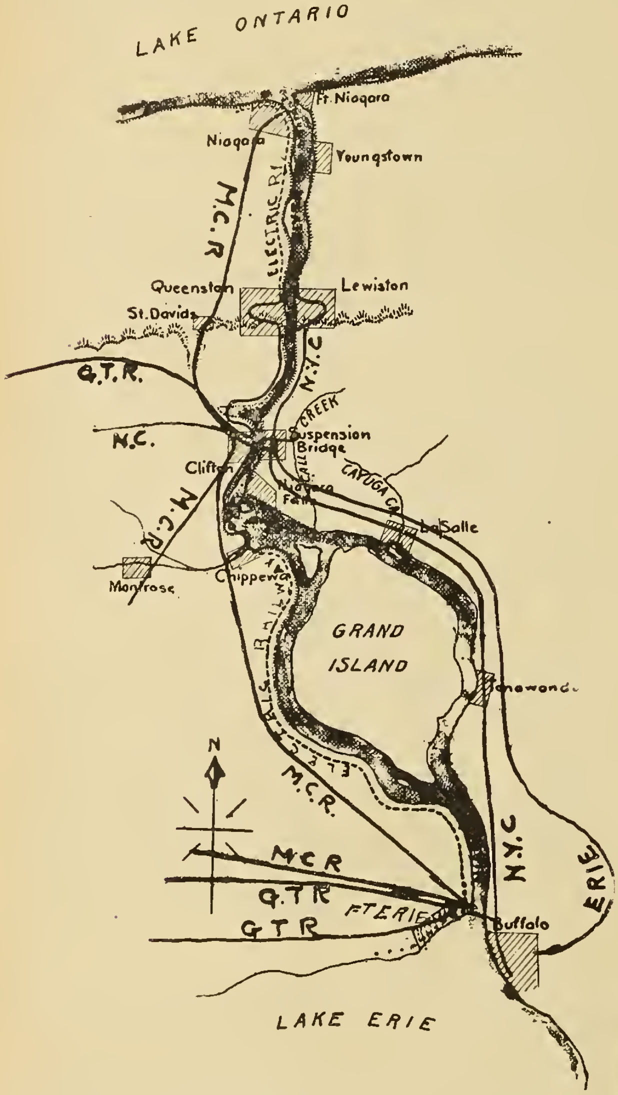
The cost of construction of the C. P. R. Telegraph line from Revelstoke to Kalso and Nelson, B. C., will be about $20,000. The work has been commenced and will be completed by the middle of September.

Messrs. W. G. Moncrief, G. A. Larkin and A. M. Macdonell, of Toronto; Arthur Goodby, of Portland, Ore., and W. C. Buckley, of Chicago, under the name of the Southwick Oil Company (Ltd.), have been granted letters of incorporation for the purpose of acquiring and controlling the business formerly carried on by Messrs. W. G. Moncrief and G. A. Larkin, dealers in lubricating oils and similar engineers' supplies. The capital stock of the company is $25,000.

ELECTRIC RAILWAY DEPARTMENT.

THE NIAGARA FALLS PARK AND RIVER RAILWAY.

A NEW electric railway which is intended to give visitors the best opportunity of viewing to advantage America's greatest wonder—Niagara—has lately been completed and put in operation. This road extends for twelve miles on the Canadian side of the Niagara river, from the wharf at Queenston, where it connects with the Toronto and other boats, to the village of Chippewa, three miles above the Falls, keeping along the bank of the river all the way excepting for a short sinuous detour which it makes in climbing the Heights at Queenston. It gives a complete view of the river throughout those parts which are visited by the tourist, following the windings of the bank so as to keep it continually in sight. It has been a year and a half in building, and though it has only been running since about the first of June, the accommodations are being taxed to the utmost to supply the demands of the increasing traffic. The company, however, are meeting this by increasing their equipment as fast as possible, and some forty cars, or twenty trains of motor cars and trailers, are now in use.



Sketch Showing Route of Niagara Falls Park and River Railway.

There is at present a single track, with some twenty turn-outs, but it may be advisable in the near future to have a double track to facilitate the moving rapidly of such large crowds as are met with in excursion traffic. As it is, the road has made a good record, carrying 1200 passengers from the Falls to Queenston in an hour and a half at one time, and at another moving six loaded trains of twelve cars up the long grade at Queenston at once, the lower power house supplying the power.

Though built primarily for passenger traffic, there is some likelihood of its also being used lucratively for carrying light freight, such as fruit, etc., down to Queenston to be shipped to Toronto and other lake ports. The running conditions for the winter are as yet somewhat uncertain, but it is intended that at least the part of the road about the Falls shall be run continuously throughout that season.

The road in construction and management is wholly Canadian. Mr. E. B. Osler, Toronto, is the President of the Board of Directors, Mr. Wm. Hendrie, Hamilton, vice-president, and Mr. R. A. Smith, Toronto, secretary. Mr. W. A. Grant, who has been connected with the Grand Trunk and Canadian Pacific railways for a number of years, is the general manager of the road. He was in the superintendent's office of the G. T. R. in 1884, and with the general superintendent of the C. P. R. in 1885, and was Mr. Van Horne's secretary from 1887 to 1892. He is a gentleman of energy and capability, and has risen rapidly to the place he now holds. Mr. W. Phillips, who is a member of the Canadian and Ontario Associations of Stationary Engineers, from the latter of which he holds a first-class certificate, and who has had an extended experience in steam and electrical engineering, is the mechanical and electrical engineer in charge.

Following are some of the more important details of construction and equipment :

THE ROAD BED.

The road was laid out under the direction of Mr. W. T. Jennings, C.E., of Toronto, who also planned the power plant at the Falls, the tail-race tunnel, wheel pit, etc. In general construction the road-bed is similar to and follows the best railroad practice, excepting that quicker curves and steeper grades are here allowed. The curves, however, are not as sharp nor the grades as steep as are found on most street railways using similar equipment. The road following the river bank, there are many curves. The quickest of these, above the Falls, has 85 feet radius. The grades also vary considerably. The most severe is that at Queenston, 1½ miles long and from 3 to 5.5 per cent., with a total drop of 346 feet. Besides this there is a short grade of 5.5 per cent. near the upper suspension bridge and several more of from 3 to 4 per cent. The road-bed is 16 feet wide on fills and 20 feet in cuttings. 56 lb. standard C. P. R. steel T rails are double-spiked to hemlock and cedar ties with broken stone ballast and for a considerable part solid rock bottom, making a very smooth and firm track. Guard rails and rail braces are used on all curves. Automatic split-rail switches are used. The bridges are mostly of steel or else standard railway trestles, and were constructed by the Hamilton Bridge Company. Over the ravine running west from the whirlpool there is a trestle bridge 500 feet long and 135 feet high, and at the Dufferin Islands there are three truss bridges, the longest of which has a span of 400 feet. Platforms are built for the accommodation of passengers at the more important stopping places along the route.

THE LINE.

The Canadian General Electric Co., of which Mr. Frederic Nicholls is general manager, had charge of the pole and overhead construction, and have furnished and placed the electrical equipment generally, the pole work etc., being under the direction of Mr. T. S. Russell, the company's civil engineer, and the electrical work under the direction of Mr. Wm. Rutherford, its electrical engineer. Excepting for two and a half miles through the park, the poles are of cedar set about 90 feet apart and six feet deep, about half of them being imbedded in rock concrete. They are painted black below and white above, and give the road a very *ship-shape* appearance. The pole brackets are neat and are so designed that one may be placed on each side of a pole, as they are in the case of turn-outs or as they would be used for a double track, the poles being between the tracks. Through the park the poles are constructed of 6 in., 5 in., 4 in. and 3 in. standard steel tubing, provided with brackets rather more ornamental than those on the wooden poles, and each surmounted by a hood, beneath which are five incandescent 32 c. p. 100 volt lamps, which are fed from a separate circuit, and grounded on the poles, the poles themselves being carefully grounded. The overhead parts are of T. & H. design. The trolley wire is of 00 B. W. G. copper, hard drawn, divided into sections insulated from one another and separately fed at their centres. From the upper station there are seven feeders, two running south of ½ and 1½ miles length No. 0 B. & S., and five north; one and two ½ and 2 miles of 0 B & S.; three, 3 miles of 000 B. W. G.; four 4 miles 0000 B. W. G.; and five consisting of 5½ miles 000000 B. W.G. in series with three miles 00 B. W. G.—All aoe weatherproof insulated wire and the sizes larger than 00 are in cable.

Power House of the Niagara Falls Park and River Railway.

The lower power house feeds directly into the trolley wire at two points on the grade in front of and behind the station, and supplies a section of about 1½ miles, which includes the long heavy grade at Queenston.

Switches are so arranged that the whole line may be supplied from either power house on occasion. For a time the lower one supplied the whole line before the upper one was started.

Double copper bands well riveted and sweated on, connect successive rails. Cross connections are made every third or fourth rail and grounds are made to the river at intervals of about a half mile.

POWER PLANT.

There are two power houses; a large stone structure, designed by ~~Mr. J. A. Balfour, of Hamilton,~~ stands just above the Falls. It is shown in end elevation in the accompanying cut, from a photograph taken before completion. In-side elevation it is really a very handsome building. The second one is of less architectural pretensions and is situated a short distance from the wharf at Queenston.

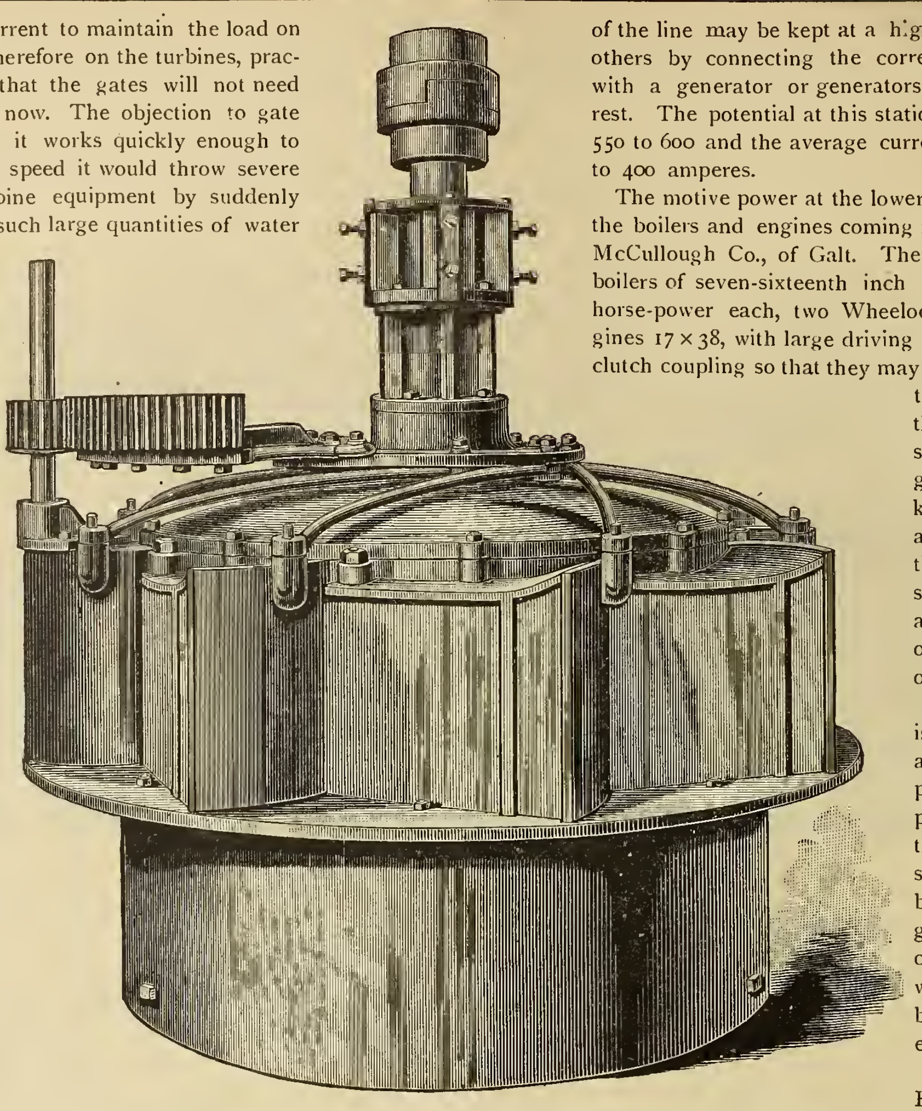
The chief engineer, Mr. Jennings, entrusted Mr. W. Kennedy, jr., to design plans for the construction of the water power, as also the arrangement of the machinery in connection therewith in the power house at the Falls. The head of water utilized is 57 feet. The wheel pit is 85 feet deep, the tail water at the bottom standing at about 12 feet. The tail race tunnel is 600 feet long and discharges underneath the Falls. The water is carried in a headrace from the foot of the upper rapids into a cut stone forebay which is fitted with iron headgates 7½ feet in diameter. From this forebay the water is conducted through two intake pipes to two vertical penstocks 44 ft. deep and 7½ ft. in diameter, made from ⅜ steel plate. These penstocks are enlarged to 10·6 diameter for five feet up from the bottom to receive the water wheels, and have steel draft tubes 9 feet long attached to the bottom plates for the water wheels. The penstocks are carried on cast iron box girders which are supported by cast iron pillars. These girders are planed off, and the bottom plates of penstocks are turned so as to ensure true even bearing surfaces. The water wheels are the well known "New American" turbines, and are particularly adapted for electrical work. There are two 45 inches in diameter, with accommodation in the wheel pit for a third, and each capable of developing 1,000 horse power under the head of water mentioned above. They make 221 revolutions per minute when at work. The upright shafts are forged steel 6 inches in diameter; they are supported by four iron bridgetrees in each penstock, and are fitted with lignum vitæ boxes and thrust bearings. The driving gears on the tops of the upright shafts are mortise wheels 75 inch diameter, 18 face and 5½ pitch. The iron pinions on the line shaft are 66½ inch diameter and the teeth are dressed on both sides. These gears are banded with heavy wrought iron bands. Each pair of wheels weighs over 6 tons. They run about four-fifths of a mile per minute at the pitch lines. The water wheels are set on a line parallel with the sides of the power house. The line shaft is forged steel 7⅛ inches in diameter, and is carried on four massive cast iron box bridgetrees supported on four heavy box girders or beams which lie over the mouth of the wheel pit. The outer sides of this shaft are carried on heavy iron stands, provided with ball and socket boxes. The pinion gears and driving pulleys are fitted on it, the pulleys being furnished with very neat friction clutches capable of picking up and transmitting 350 horse power each.

[illegible] arrive at the Falls

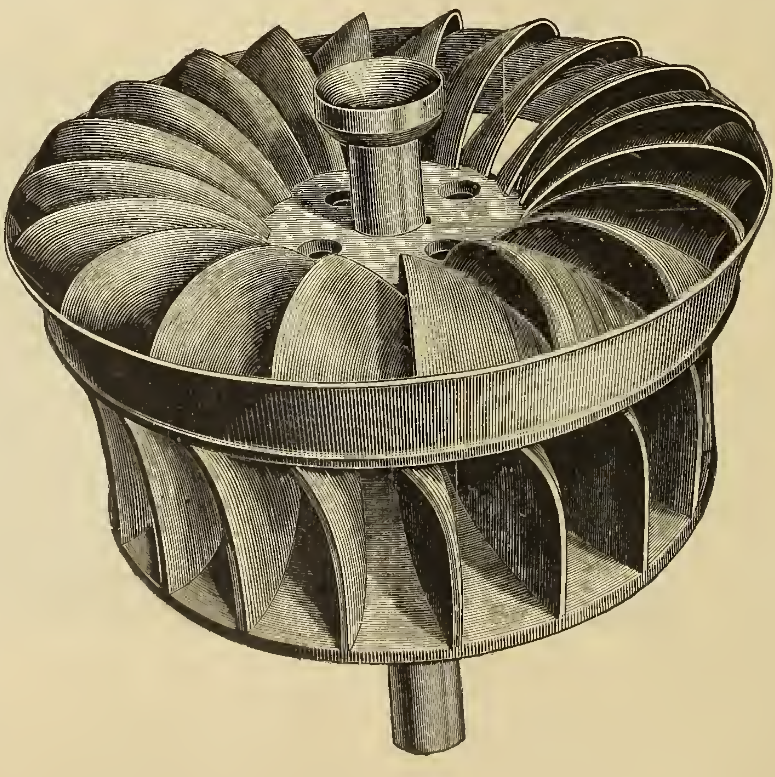
As either of the water wheels is capable of developing more power than is required to drive the whole of the present electric plant, only one is used to do the work, the other being held in reserve in case of accident, the shafting having been designed to provide for such contingencies.

The regulation of the turbine gates is at present accomplished by hand, but it is intended to have automatic regulators consisting of resistance shunts connected with each of the generators to take sufficient current to maintain the load on the generators and therefore on the turbines, practically constant, so that the gates will not need constant attention as now. The objection to gate regulation is that if it works quickly enough to maintain a constant speed it would throw severe strains upon the turbine equipment by suddenly stopping the flow of such large quantities of water as are here employed, and of course the sudden changes of load which are met with in railroad practice act very severely upon the whole power plant.

Messrs. Wm. Kennedy & Sons, of Owen Sound, Ont., were the contractors for the water wheels, penstocks, shafting, gearing, etc., etc., and although the bulk of the work in connection with placing this machinery had to be done during the cold stormy weather of the latter part of last winter, without covering from the heavy spray from the Falls, and under other very difficult surroundings, yet, without any preliminary run the machinery was set to work on the 10th of June last and run continuously for 15 hours per day ever since without stop or trouble of any kind, which is certainly an indication that their work has been well done.



The power house and wheel pit have been constructed to allow for extension, as there is some probability of the company supplying power to run stationary motors in the neighborhood of the Falls. Illustrations of the water wheels employed are given herewith.



For each turbine there will be four generators, the style selected has been the T. H. multipolar of 200 kwt capacity. These generators, as well as the motors in the cars, and indeed the whole of the electrical apparatus, were manufactured at the Peterboro' works of the Canadian General Electric Co.

The switch board is divided in seven sections and is of polished slate set in an iron frame. Following the course of the current from the positive brush we have in order: three-way switch machine meter, buss-bar, in three sections, for the three machines at present running, feeder switches, feeder meters of the Edison type, then out to the feeders; returning from ground through total meter, ground, buss, then through machine circuit breakers of T. H. pattern, to three-way switch and back to machine passing through series field and negative brush. Switches also provide that parts of the line may be kept at a higher pressure than others by connecting the corresponding feeders with a generator or generators isolated from the rest. The potential at this station is kept at from 550 to 600 and the average current runs from 300 to 400 amperes.

The motive power at the lower station is steam, the boilers and engines coming from the Goldie & McCullough Co., of Galt. There are two tubular boilers of seven-sixteenth inch steel, rated at 150 horse-power each, two Wheelock condensing engines 17 × 38, with large driving wheel and with a clutch coupling so that they may be run in conjunction. At present these drive an Edison and a T. H. generator of 100 kwts each. The two are not used continually, one being sufficient for the average load. The other is thrown in on special occasion.

The switch board is in two sections and the current passes from the positive brush, through three-way switch, T.H. meters, buss-bar, feeders, ground, buss, circuit breakers, three-way switch and back to the generator.

Cars and Car Equipment.—The cars have been constructed by Patterson & Corbin, of St. Catharines, and include: 10 observation motor cars, with three seats running lengthwise and with double truck, 10 open motor cars with reversible cross seats, 3 closed motor cars of ordinary type, 1 parlor car, 1 baggage car, 12 open trailers with reversible cross seats and 4 closed cars. They are handsome and well built and in keeping with the general excellence of equipment of the road. The trucks furnished by the McGuire Manufacturing Company of Chicago, are specially heavy, the wheels are 33 in. diam. with $3\frac{1}{2}$ in. tread and $1\frac{1}{2}$ in. flange. Each car is run by two T.H. W.P. 50 motors of 25 h. p. each. They are operated with the new series parallel controller, there being no field commutation as in the Edison system. The gradations in power are obtained by the use of a rheostat and by changing the two motors from parallel to series with respect to each other or vice-versa.

There is at present one car house, situated near Chippawa, with accommodation for 25 cars; a second one will soon be built near the centre of the line.

At the whirlpool rapids there is an incline railway which is run in connection with the road, and which is worked after a novel though simple manner. There are two cars with seats in steps made to hold from 15 to 20 people. These are on the inclined rails and are connected to each other by a double steel cable which passes over a drum at the top of the slope, so that when one car is descending the other is ascending, and when one is at the bottom the other is at the top. The drum, and with it the cars, is stopped by a friction brake worked by a man at the top. Each car is provided with a large tank underneath the seats and when the car is at the top, water, which is supplied from a neighboring stream, is poured rapidly into this until there is sufficient to overbalance the car below, which has in the meantime been discharged when it reached the bottom. The capacity of the tank is sufficient to allow the car going down light to bring up the other loaded.

SPARKS.

The Calgary Light, Power & Heating Company is seeking incorporation.

The Edmonton Electrical Company have made application for incorporation.

The Keegans-Milne Company, of Montreal, who were burned out last February, have assigned.

The Hamilton, Grimsby and Beamsville Electric Railroad bonus by-law has been carried at Hamilton.

The Steam Boiler and Plate Glass Insurance Company has received a license to transact business in Canada.

Mr. George Perkins has purchased the Links Mica Mine in Hull Township, and has about 16 men employed thereon.

The Town of Waterloo, Que., intend using the water power at Brome Lake outlet, for running an electric light plan .

The Lethridge Waterworks and Electric Light Company have let the contract for the construction of their power house.

The Hamilton Street Railway Company have recently placed another dynamo and engine in their power house.

George Barbeau a line man in the employ of the Standard Electric Company, Ottawa, was killed a few days ago by coming in contact with a live wire.

Captain Lorway, manager of the Bras D'Or Steamship Company, has purchased the steamer "Blue Hill," of Yarmouth, at a cost of about $13,000. The Blue Hill will run between Mulgrave, St. Peter's, and East Bay.

The General Electric Company, of New York, is working two Canadian mica mines, one at Sydenham, (near Kingston,) and the other at Cantly, Que.

The Reliance Manufacturing Company, of Waterford, are now manufacturing alternating dynamos and have just completed one of 1,000 lights capacity.

Messrs. Geo. H. Harper & Company have been granted the privilege of erecting poles and wires for the distribution of electric light, heat and power in the streets of Dundas, Ont.

There seems to be a steady demand for Canadian mica both from England and the United States. The two principal American buyers are the Westinghouse Company, of Pittsburgh, and the General Electric Company, of New York.

The Toronto Electric Light Company will furnish the power for the operation of the Toronto and Scarboro' Electric Street Railway, to produce which they have had a 150 h. p. generator placed in their power house by the Reliance Manufacturing Company, of Waterford.

An injunction was granted restraining the Street Railway Companies of Ottawa, from carrying out the agreement signed recentlv, of which mention has been made. The work on the street railway lines has been stopped and about 125 men thrown out of employment.

President J. W. McRae of the Ottawa Electric Street Railway Company says that the gross receipts for the Company's financial year were $109,000, of which $10,000 was carried to the reserve fund after a dividend of 8% had been paid. The number of fares collected was 2,394,000.

The Toronto Incandescent Light Company have added a 700 h. p. vertical cross-compound engine to their plant. They will have two large dynamos directly connected with the engine shaft. This will give an additional capacity of 10,000 sixteen candle power lamps, the present capacity is over 25,000 lamps. A new brick chimney 150 feet high is also being erected.

It is understood that the Canadian General Electric Company is about to establish a factory for the manufacture of electric elevators, and will combine with it the incandescent lamp manufactory, at present located in Hamilton. These combined works will require the employment of about one hundred men, and will probably be located at Toronto.

An arrangement has been concluded by the Ottawa Electric Street Railway Company, the Ottawa Horse-car Street Railway Company and the City Corporation, by which the two companies amalgamate and give a complete electric service. and receive a thirty years' franchise. The company will pay a rental of $450 per mile, and will keep the streets clean of snow, except what is required for sleighiug. The two companies have about fifteen miles of track.

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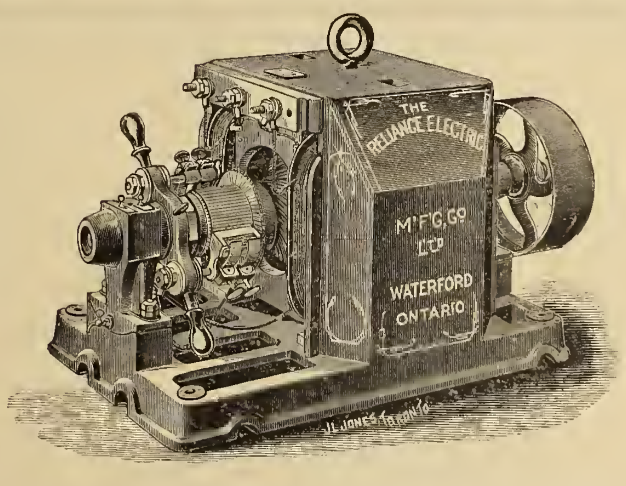

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SPARKS.

Burlington (or Hamilton) Beach was lighted by electricity for the first time on the night of July 3rd. A plant consisting of a 30 light T. & H. arc dynamo and 25 2,000 c. p. arc lamps was installed by the Hamilton Electric Light & Power Co. This plant was put in, pole line built, (covering about 1¼ miles,) house erected, 3 miles of wire strung, engine and boiler installed, a well sunk for water and 25 arc lamps hung all in 10 days time—one of the quickest installations on record.

Although it has only been running some seven years it is now quite a curiosity to see the double, suspended trolley and the Vandepoele car equipment on the oldest Canadian electric road, between St. Catharines, Merritton and Thorold. It illustrates how rapidly electrical methods and appliances are changing. But this will soon be seen no more, for the road has recently changed hands and under the control of Messrs. Dawson & Symmes with Mr. H. D. Symmes as general manager, it is being rapidly remodelled. A large part of the track has been relaid with T rails and bonded preparatory to the use of the single trolley with ground return, three new cars provided with T. H., W. P. 25 h. p. motors, three new trailers have been added to the rolling stock and a new car house with accommodation for 14 cars, with commodious offices and machine shop and blacksmith shop in connection has just been completed, being located in a central position on St. Paul St., St. Catharines. The company have still 7 cars equipped with the Vandepoele system, which are mostly kept as reserves. The power plant now consists of two turbines, a Cole wheel of 135 h. p., and a new Bass wheel made in Peterboro', of 185 h. p., and the generators are a Vandepoele 75 kwt. and a new Edison 100 kwt. It is located on the line near Thorold, and is supplied with water ftom the canal. There are at present about 8 miles of track in two lines, starting from the corner of Ontario and King Sts., St. Catharines, passing along Ontario and St. Paul Streets and dividing, one branch going to the cemetery out near the new canal, and the other following the road through Merritton and Thorold. If satisfactory arrangements can be made with the Dominion Government regarding the crossing of bridges on the canal the road will be pushed through from the St. Catharines terminus to Port Dalhousie, thus improving the connection between this city and Toronto and the lake ports.

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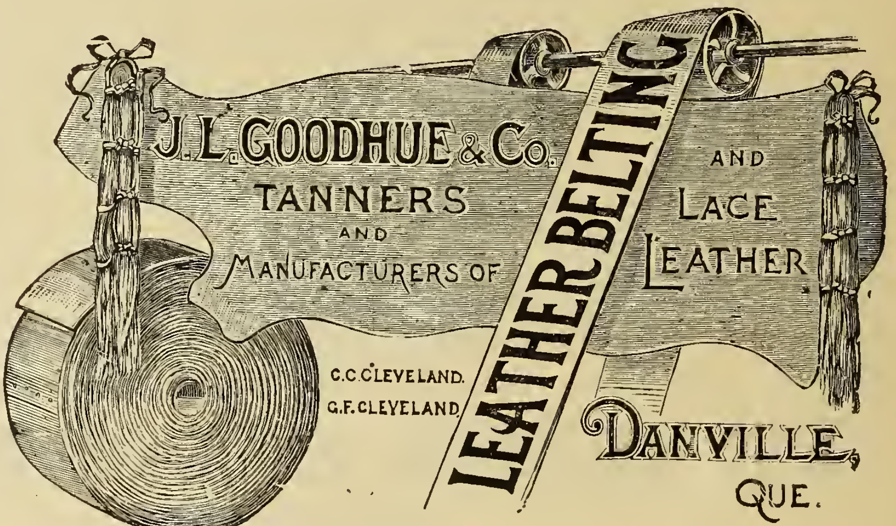

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SPARKS.

The engine in the Windsor electric light station is said to be giving trouble and will be replaced by a new one.

The new power station of the Toronto Street Railway is claimed to have the finest switch board of the kind in America.

At the annual meeting of the American Boiler Manufacturers' Association of the United States and Canada, held at Chicago on June 13th, Mr. F. E. Leonard, of London, Ont., was elected third vice-president.

The Toronto Street Railway Co. are substituting iron for wooden poles on some of the principal streets of Toronto. It is a subject of wonder that these new poles should have been painted red. Is it to further emphasize the danger which the public has been taught to believe attaches to everything electrical.

The telephone has lately been arranged for use of divers. A sheet of copper is used in place of one of the glasses in the helmet, and to this a telephone is fixed so that the diver, when at the bottom of the sea, has only to slightly turn his head in order to report what he sees, or receive instruction from above.

The Buffalo Street Railway are now operating a large number of cars requiring on an average from 1,800 to 2,000 h. p. The plant is capable of supplying some 4,000 h. p. They use high speed cross compound condensing engines in units of 500 h. p. and of two types—the Ball horizontal, and a Wilson vertical, the latter made by a firm in the city. A peculiarity of their switch board is that they use no circuit breakers, relying upon fuses instead, and they claim that these work very satisfactorily. They have quite a number of double truck cars on their lines.

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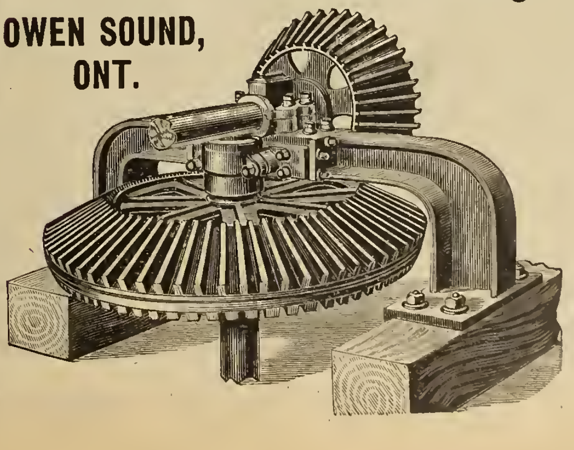

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Dr. Elsasser, of Berlin, states that a new kind of telephone wire, having a low electrical resistance and of great tensile strength, is being experimented with in Germany. It consists of an aluminum bronze core in a copper-bronze envelope.

The original telephone patent of A. Graham Bell, which expired recently, was perhaps the only patent controlled by the Bell Company which was never disputed. Its broad claim was: "The method of, and apparatus for, transmitting vocal or other sounds, telegraphically, as herein described, causing electrical undulations similar in form to the vibrations of the air accompanying the said vocal and other sounds, substantially as set forth."

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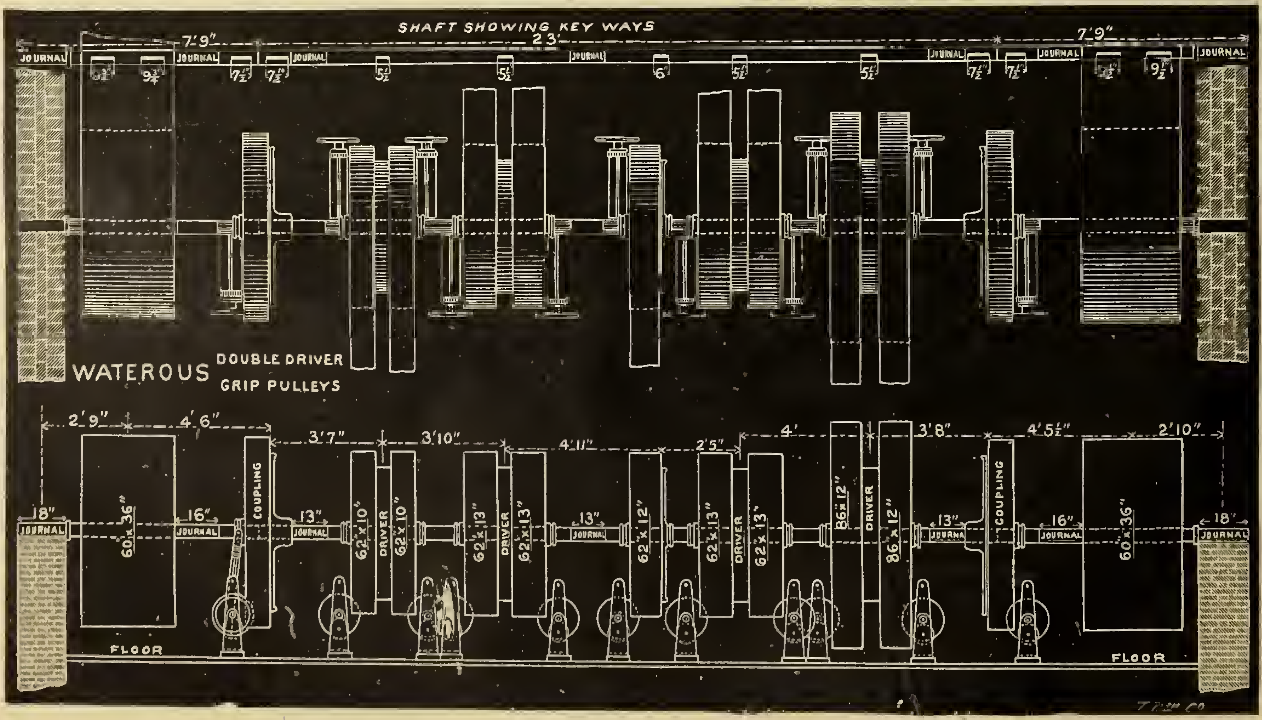

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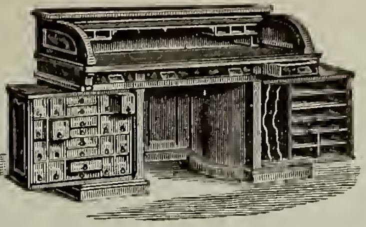

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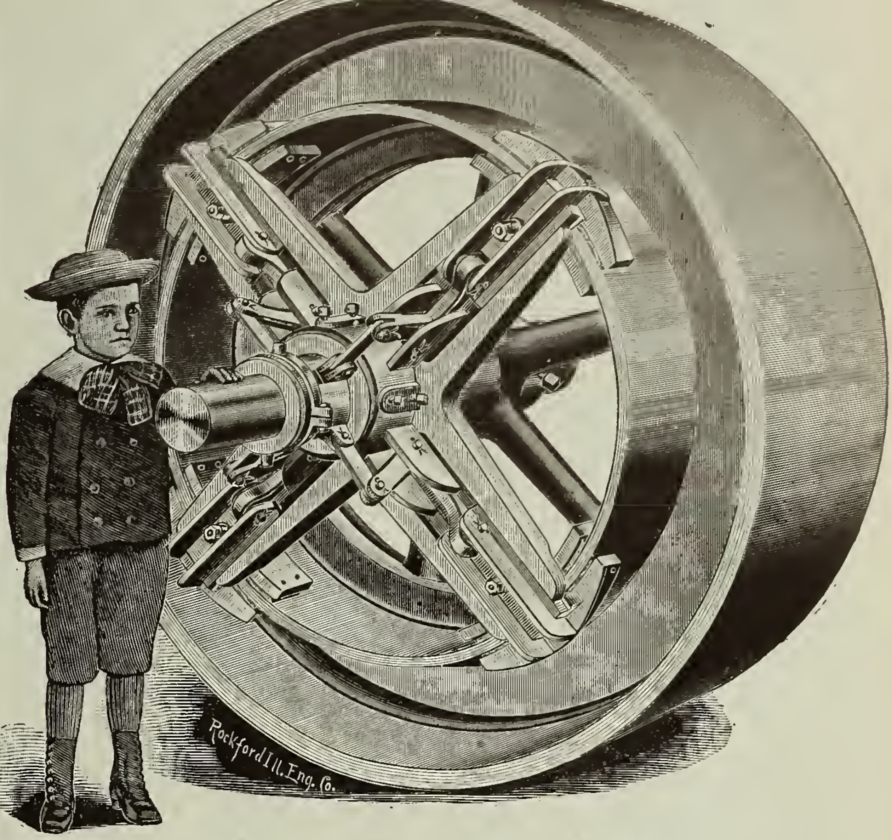
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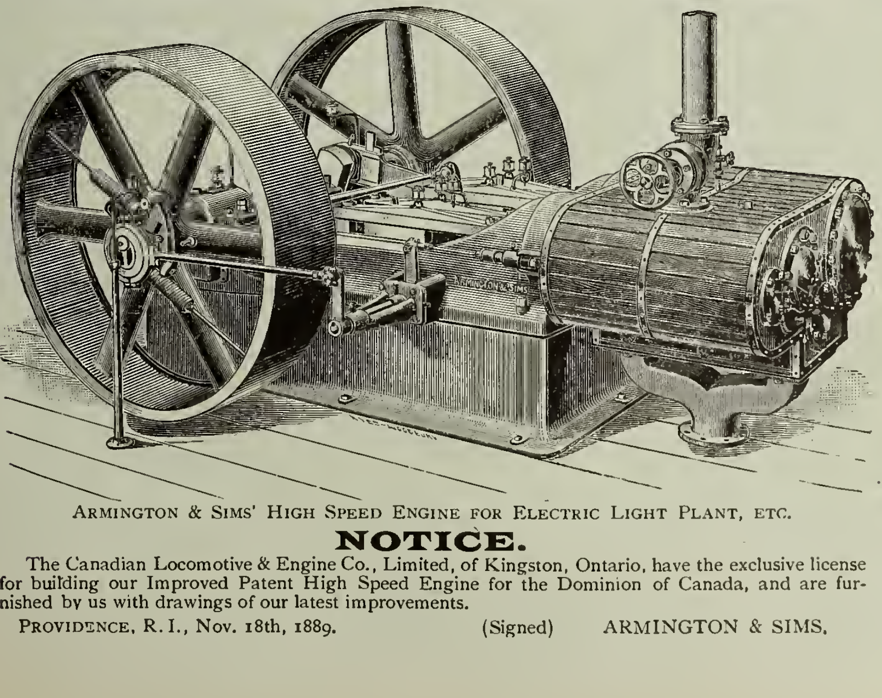

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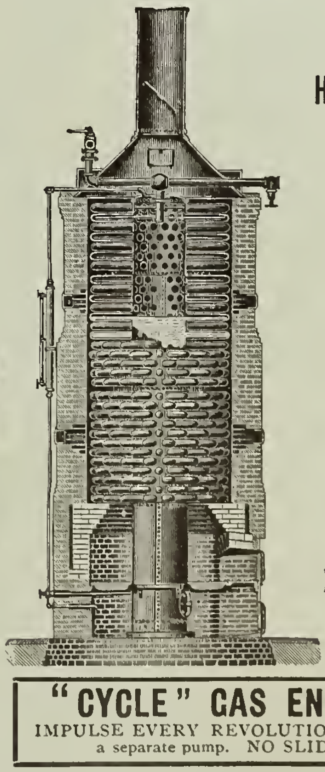

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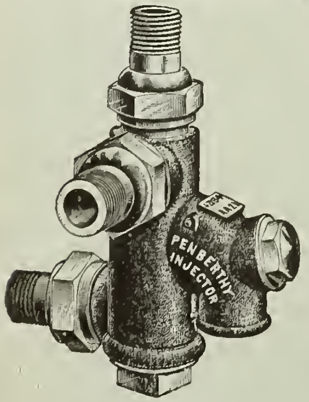

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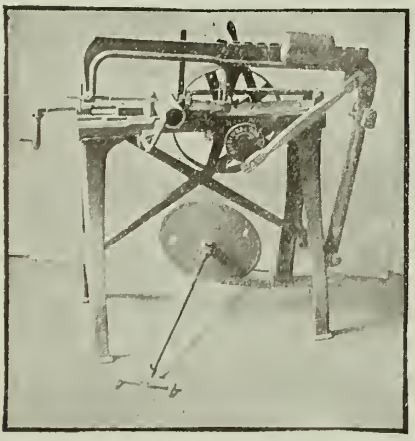

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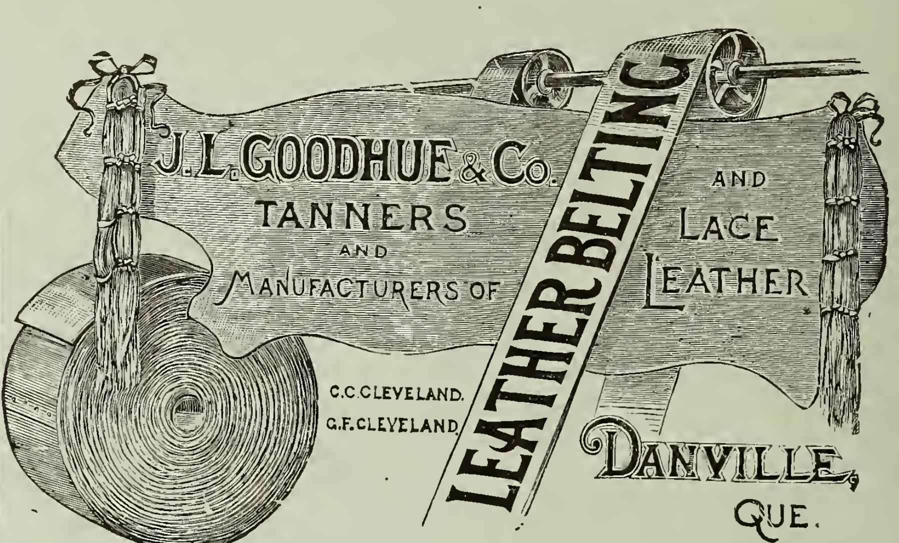

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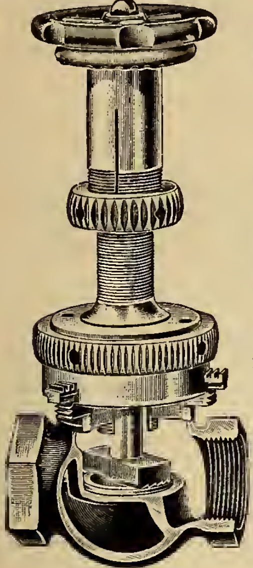

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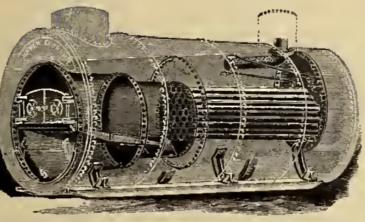

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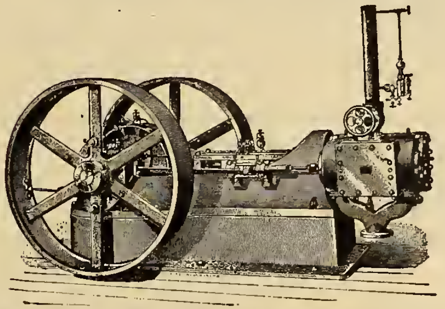

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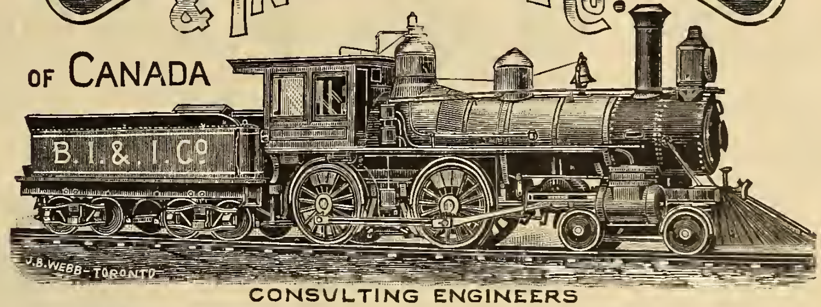

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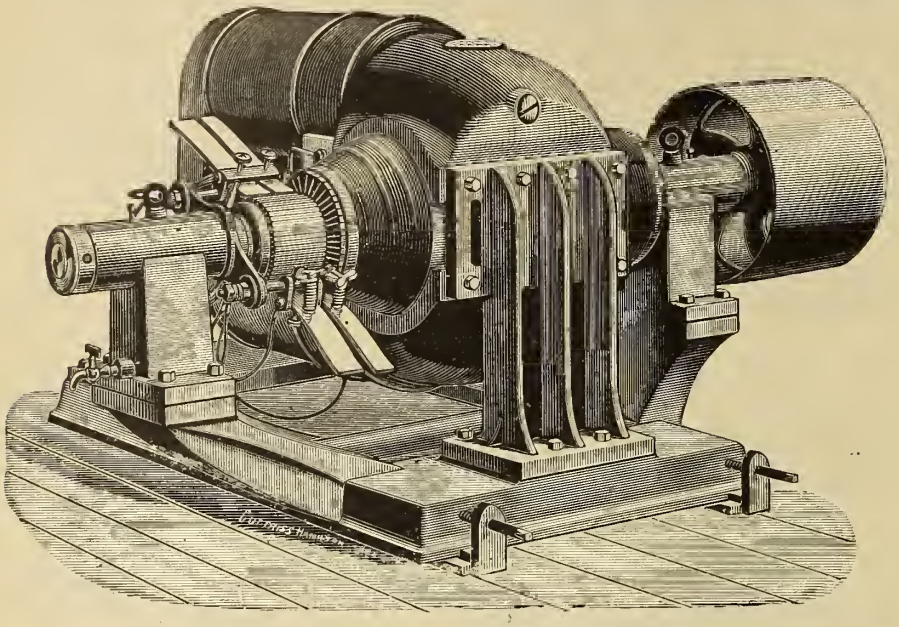

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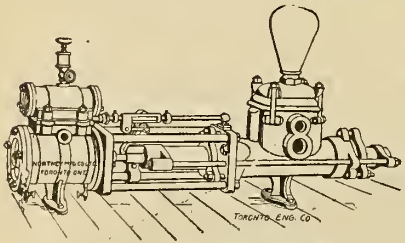

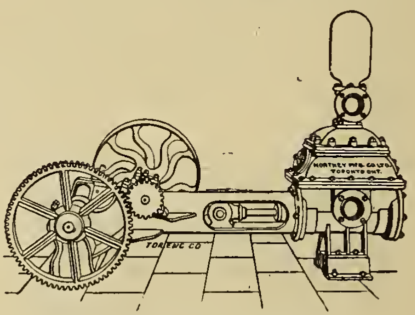

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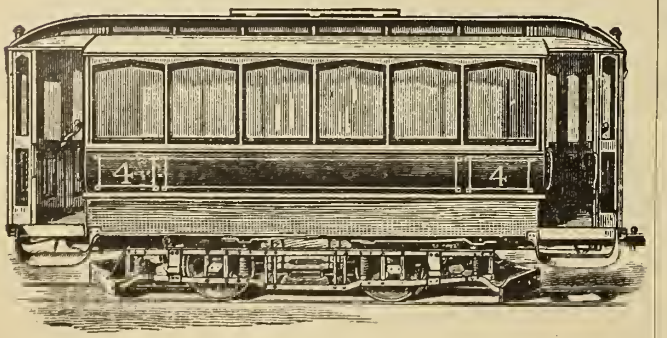

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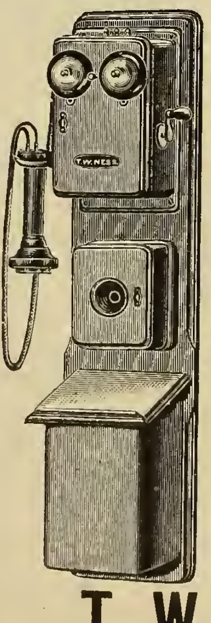

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ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.*

BY NIKOLA TESLA.

INTRODUCTORY.

WHEN we look at the world around us, on Nature, we are impressed with its beauty and grandeur. Each thing we perceive, though it may be vanishingly small, is in itself a world, that is, like the world of the visible universe, matter and force governed by law—a world, the contemplation of which fills us with feelings of wonder and irresistibly urges us to ceaseless thought and inquiry. But in all this vast world, of all objects our senses reveal to us, the most marvellous, the most appalling to our imagination, appears nodoubt a highly developed organism, a thinking being. If there is anything fitted to make us admire Nature's handiwork, it is certainly this inconceivable structure, which performs its innumbeable motions in obedience to external influence. To understand its workings, to get a deeper insight into this Nature's master-piece, has ever been for thinkers a fascinating aim, and after many centuries of arduous research men have arrived at a fair understanding of the functions of its organs and senses. Again, in all perfect harmony of its parts, of parts which constitute the material or tangible of our being, of all its organs and senses, the eye is the most wonderful. It is the most precious, the most indispensable of our respective or directive organs, it is the great gateway through which all knowledges enters the mind. Of all our organs it is the one which is in the most intimate relation with that which we call intellect. So intimate is this relation, that it is often said that the very soul shows itself in the eye.

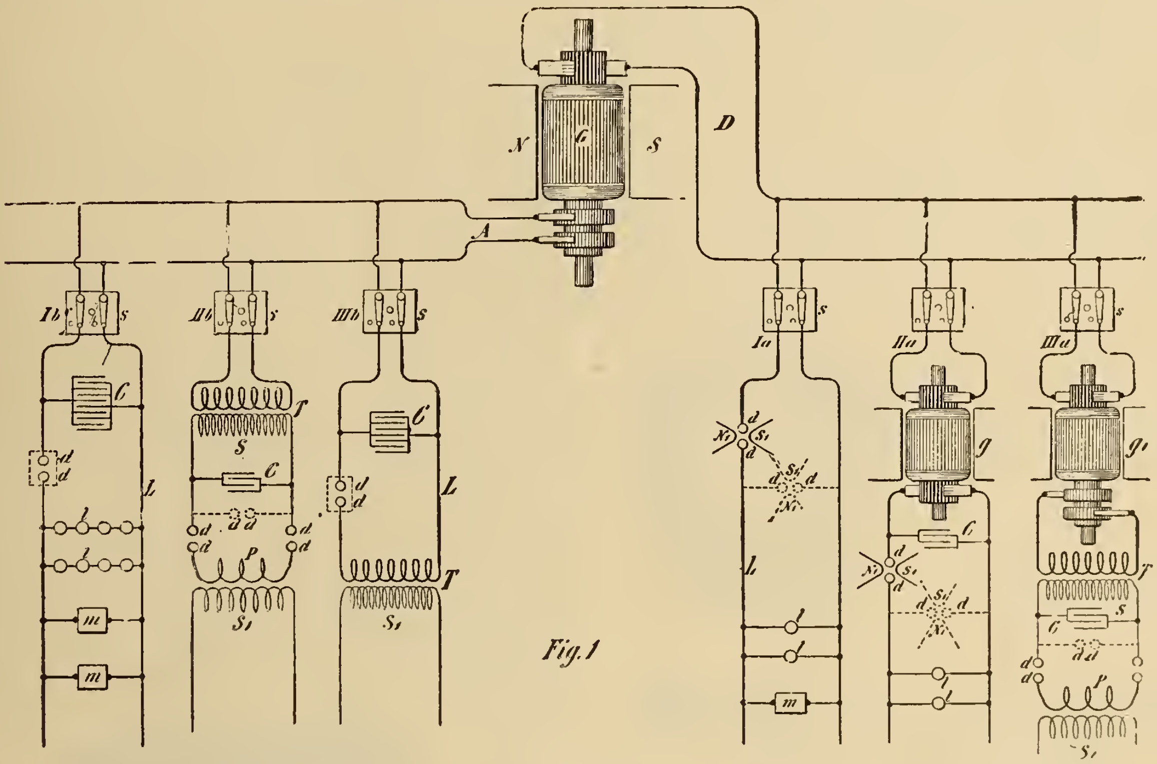

Fig. 1

PLAN OF CONNECTIONS USED IN THE CONVERSION BY MEANS OF THE DISRUPTIVE ARC DISCHARGE.

It can be taken as a fact which the theory of the action of the eye implies, that for each external impression, that is, for each image produced upon the retina, the ends of the visual nerves, concerned in the conveyance of the impression to the mind, must be under a pecular stress or in a vibratory state. It now does not seem improbable that, when by the power of thought an image is evoked, a distinct reflex action, no matter how weak, is exerted upon certain ends of the visual nerves, and therefore upon the retina. Will it ever be within human power to analyze the condition of the retina when disturbed by thought or reflex action, by the help of some optical or other means of such sensitiveness that a clear idea of its state might be gained at any time? If this were possible, then the problem of reading one's thoughts with precision, like the characters of an open book, might be much easier to solve than many problems belonging to the domain of positive physical science in the solution of which many, if not the majority, of scientific men implicitly believe. Helmholtz has shown that the fundi of the eyes are themselves luminous, and he was able to see, in total darkness, the movement of his arm by the light of his own eyes. This is one of the most remarkable experiments recorded in the history of science, and probably only a few men could satisfactorily repeat it, for it is very likely that the luminosity of the eyes is associated with uncommon activity of the brain and great imaginative power. It is fluorescence of brain action, as it were.

Another fact having a bearing on this subject which has probably been noted by many, since it is stated in popular expressions, but which I cannot recollect to have found chronicled as a positive result of observation, is that at times, when a sudden idea or image presents itself to the intellect, there is a distinct and sometimes painful sensation of luminosity produced in the eye, observable even in broad daylight.

The saying then that the soul shows itself in the eye is deeply founded, and we feel that it expresses a great truth. It has a profound meaning even for one who, like a poet or artist, only following his inborn instinct or love for Nature, finds delight in aimless thoughts and in the mere contemplation of natural phenomena, but a still more profound meaning for one who, in the spirit of positive scientific investigation, seeks to ascertain the causes of the effects. It is principally the natural philosopher, the physicist, for whom the eye is the subject of the most intense admiration.

Two facts about the eye must forcibly impress the mind of the physicist, notwithstanding he may think or say that it is an imperfect optical instrument, forgetting that the very conception of that which is perfect, or seems so to him, has been gained through this same instrument. First, the eye is, as far as our positive knowledge goes, the only organ which is directly affected by that subtle medium which, as science teaches us, must fill all space; secondly, it is the most sensitive of our organs, incomparably more sensitive to external impressions than any other.

---

*A lecture delivered before the Franklin Institute, at Philadelphia, Feb. 24th, 1893, and before the National Electric Light Association, at St. Louis, Mo., March 1, 1893.

The organ of hearing implies the impact of ponderable bodies, the organ of smell the transference of detached material particles, and the organs of taste and of touch or force, the direct contact, or at least some interference of ponderable matter, and this is true even in those instances of animal organisms, in which some of these organs are developed to a degree of truly marvelous perfection. This being so, it seems wonderful that the organ of sight solely should be capable of being stirred by that which all our other organs are powerless to detect, which yet plays an essential part in all natural phenomena, which transmits all energy and sustains all motion, and, that most intricate of all, life, but which has properties such that even a scientifically trained mind cannot help drawing a distinction between it and all that is called matter. Considering merely this, and the fact that the eye, by its marvelous power, widens our otherwise very narrow range of perception far beyond the limits of this small world which is our own, to embrace myriads of other worlds, suns and stars in the infinite depths of the universe, would make it justifiable to assert that it is an organ of a higher order. Its performances are beyond comprehension. Nature, as far as we know, never produced anything more wonderful. We can get barely a faint idea of its prodigious power by analyzing what it does and by comparing. When ether waves impinge upon the human body, they produce the sensations of warmth or cold, pleasure or pain, or perhaps other sensations of which we are not aware, and any degree or intensity of these sensations, which degrees are infinite in number, hence an infinite number of distinct sensations. But our sense of touch, or our sense of force, cannot reveal to us these differences in degree or intensity, unless they are very great. Now we can readily conceive how an organism, such as the human in the eternal process of evolution, or, more philosopically speaking, adaptation to Nature, being constrained to the use of only the sense of touch or force, for instance, might develop this sense to such a degree of sensitiveness or perfection that it would be capable of distinguishing the minutest differences in the temperature of a body even at some distance, to a hundredth, or thousandth, or millionth part of a degree. Yet, even this apparently impossible performance would not begin to compare with that of the eye, which is capable of distinguishing and conveying to the mind in a single instant innumerable peculiarities of the body, be it in form or color or other respects. This power of the eye rests upon two things, namely, the rectillinear propagation of the disturbance by which it is affected, and upon its sensitiveness. To say that the eye is sensitive is not saying anything. Compared with it, all other organs are monstrously crude. The organ of smell which guides a dog on the trail of a deer, the organ of touch or force which guides an insect in its wanderings, the organ of hearing, which is affected by the slightest disturbances of the air, are sensitive organs, to be sure, but what are they compared with the human eye! No doubt it responds to the faintest echoes or reverberations of the medium; no doubt, it brings us tidings from other worlds, infinitely remote, but in a language we cannot as yet always understand. And why not? Because we live in a medium filled with air and other gases, vapors and a dense mass of solid particles flying about. These play an important part in many phenomena; they fritter away the energy of the vibrations before they can reach the eye; they too, are the carriers of germs of destruction, they get into our lungs and other organs, clog up the channels and imperceptibly, yet inevitably, arrest the stream of life. Could we but do away with all ponderable matter in the line of sight of the telescope, it would reveal to us undreamt of marvels. Even the unaided eye, I think, would be capable of distinguishing in the pure medium small objects at distances measured probably by hundreds or perhaps thousands of miles.

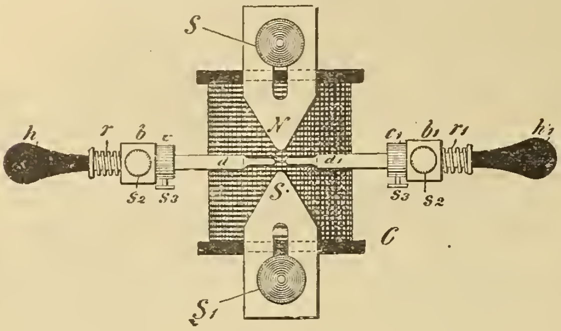

Fig. 2

FORM OF DISCHARGER WITH MAGNET USED IN THE DIRECT CURRENT CONVERSION.

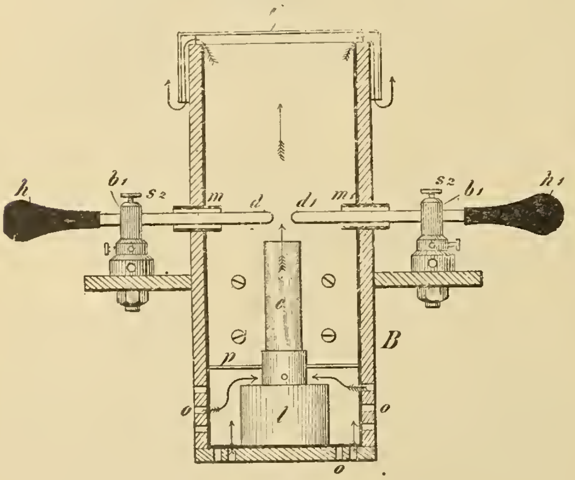

Fig. 3

DISCHARGES WITH HOT AIR DRAUGHT.

But there is something else about the eye which impresses us still more than these wonderful features which we observe, viewing it from the standpoint of a physicist, merely as an optical instrument—something which appeals to us more than its marvelous faculty of being directly affected by the vibrations of the medium, without interference of gross matter, and more than its inconceivable sensitiveness and discerning power. It is its significance in the processes of life. No matter what one's views on Nature and life may be, he must stand amazed when, for the first time in his thoughts, he realizes the importance of the eye in the physical process and mental performances of the human organism. And how could it be otherwise, when he realizes that the eye is the means through which the human race has acquired the entire knowledge it possesses, that it controls all our motions, more still, all our actions.

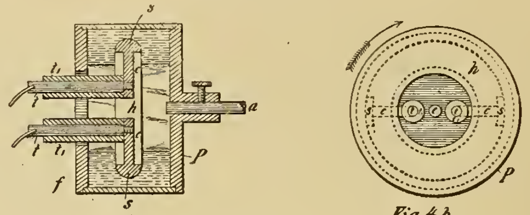

Fig. 4a Fig. 4b

FORM OF DISCHARGER WITH LIQUID INTERRUPTER.

There is no way of acquiring knowledge except through the eye. What is the foundation of all philosophical systems of ancient and modern times, in fact of all the philosophy of man? I am, I think; I think, therefore I am. But how could I think and how would I know that I exist, if I had not the eye? For knowledge involves consciousness; consciousness involves ideas, conceptions; conceptions involve pictures or images, and images the sense of vision, and therefore the organ of sight. But how about blind men, will be asked? Yes, a blind man may depict in magnificent poems forms and scenes from real life, from a world he physically does not see. A blind man may touch the keys of an instrument with unerring precision, may build the fastest boat, may discover and invent, calculate and construct, may do still greater wonders—but all the blind men who have done such things have descended from those who had seeing eyes. Nature may reach the same result in many ways. Like a wave in the physical world, in the infinite ocean of the medium which pervades all, so in the world of organisms, in life, an impulse started proceeds onward, at times, maybe with the speed of light, at times, again, so slowly that for ages and ages it seems to stay, passing through processes of a complexity inconceivable to men, but in all its forms, in all its stages, its energy ever and ever integrally present. A single ray of light from a distant star falling upon the eye of a tyrant in bygone times may have altered the course of his life, may have changed the destiny of nations, may have transformed the surface of the globe, so intricate, so inconceivably complex are the processes in Nature. In no way can we get such an overwhelming idea of the grandeur of Nature than when we consider that in accordance with the law of the conservation of energy, throughout the infinite, the forces are in a perfect balance, and hence the energy of a single thought may determine the motion of a universe. It is not necessary that every individual, not even that every generation or many generations, should have the physical instrument of sight, in order to be able to form images and to think, that is, form ideas or conceptions; but sometime

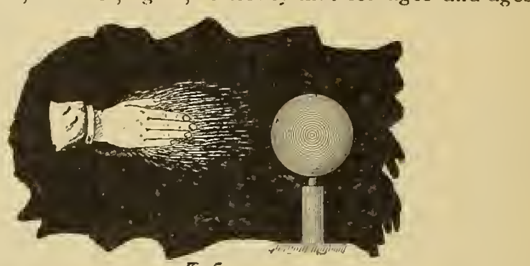

Fig. 5

ILLUSTRATING THE EFFECT OF VARYING ELECTROSTATIC FORCE WITH A TRANSFORMER OF 200,000 VOLTS PRESSURE.

or other, during the process of evolution, the eye certainly must have existed, else thought, as we understand it, would be impossible; else conceptions, like spirit, intellect, mind, call it as you may, could not exist. It is conceivable that in some other world, in some other beings, the eye is replaced by a different organ, equally or more perfect, but these beings cannot be men.

Now what prompts us to all voluntary motions and actions of any kind? Again the eye. If I am conscious of the motion, I must have an idea of conception, that is, an image, therefore the eye. If I am not precisely conscious of the motion, it is because the images are vague or indistinct, being blurred by the superimposition of many. But when I perform the motion, does the impulse which prompts me to the action come from within or from without? The greatest physicists have not disdained to endeavor to answer this and similar questions, and have at times abandoned themselves to the delights of pure and unrestrained thought. Such questions are generally considered not to belong to the realm of positive physical science, but will before long be annexed to its domain. Helmholtz has probably thought more on life than any other modern scientist. Lord Kelvin expressed his belief that life's process is electrical, and that there is a force inherent to the organism and determining its motions. Just as much as I am convinced of any physical truth I am convinced that the motive impulse must come from the outside. For, consider the lowest organism we know—and there are probably many lower ones—an aggregation of a few cells only. If it is capable of voluntary motion, it can perform an infinite number of motions, all definite and precise. But now a mechanism consisting of a finite number of parts, and a few at that, cannot perform an infinite number of definite motions, hence the impulses which govern its movements must come from the environment. So the atom, the ulterior element of the universe's structure, is tossed about in space eternally, a play to external influences, like a float in a troubled sea. Were it to stop its motion it would die. Matter at rest, if such a thing could exist, would be matter dead. Death of matter! Never has a sentence of deeper philosophical meaning been uttered. This is the way in which Prof. Dewar forcibly expresses it in the description of his admirable experiments, in which liquid oxygen is handled as one handles water, and air at ordinary pressure is made to condense and even to solidify by the intense cold. Experiments, which serve to illustrate, in his language, the last feeble manifestations of life, the last quiverings of matter about to die. But human eyes shall not witness such death. There is no death of matter, for throughout the infinite universe all has to move, to vibrate; that is to live.

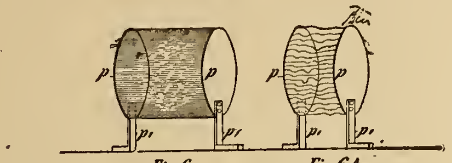

Fig. 6a Fig. 6b

Illustrating the Effects of Rapidly Varying and Steady Electrostatic Force.

I have made the preceding statements at the peril of treading upon metaphysical ground in my desire to introduce the subject of this lecture in a manner not altogether uninteresting, I may hope, to an audience such as I have the honor to address. But, now then, returning to the subject, this divine organ of sight, this indispensable instrument for thought and all intellectual enjoyment, which lays open to us the marvels of this universe, through which we have acquired what knowledge we possess, and which prompts us to, and controls, all our physical and mental activity. By what is it affected? By light! What is light?

We have witnessed the great strides which have been made in all departments of science in recent years. So great have been the advances that we cannot refrain from asking ourselves, Is this all true, or is it but a dream? Centuries ago men have lived, have thought, discovered, invented, and have believed that they were soaring, while they were merely proceeding at a snail's pace. So we, too, may be mistaken. But taking the truth of the observed events as one of the implied facts of science, we must rejoice in the immense progress already made, and still more in the anticipation of what must come, judging from the possibilities opened up by modern research. There is, however, an advance which we have been witnessing, which must be particularly gratifying to all lovers of progress. It is not a discovery, or an invention, or an achievement in any particular direction. It is an advance in all directions of scientific thought and experiment. I mean the generalization of the natural forces and phenomena, the looming up of a certain broad idea on the scientific horizon. It is this idea which has, however, long ago taken possession of the most advanced minds, to which I desire to call your attention, and which I intend to illustrate, in a general way, in these experiments, as the first step in answering the question, "What is light?" and to realize the modern meaning of this word.

It is beyond the scope of my lecture to dwell upon the subject of light in general, my object being merely to bring presently to your notice a certain class of light effects and a number of phenomena observed in pursuing the study of these effects. But to be consistent in my remarks it is necessary to state that according to that idea, now accepted by the majority of scientific men as a positive result of theoretical and experimental investigation, the various forms or manifestations of energy which were generally designated as "electric," or more precisely "electromagnetic," are energy manifestations of the same nature as those of radiant heat and light. Therefore, the phenomena of light and heat, and others besides these, may be called electrical phenomena. Thus electrical science has become the mother science of all, and its study has become all important. The day when we shall know what "electricity" is will chronicle an event probably greater, more important than any other recorded in the history of the human race. The time will come when the comfort, the very existence perhaps of man will depend upon that wonderful agent. For our existence and comfort we require heat, light and mechanical power. How do we get these? We get them from fuel, we get them by consuming material. What will man do when the forests disappear? when the coal fields are exhausted? Only one thing, according to our present knowledge will remain; that is, to transmit power at great distances. Men will go to the waterfalls, to the tides, which are the stores of an infinitesimal part of Nature's immeasurable energy. There will they harness the energy and transmit the same to their settlements, to warm their homes by, to give them light, and to keep their obedient slaves, the machines, toiling. But how will they transmit this energy if not by electricity? Judge then, if the comfort, nay, the very existence, of man will not depend on electricity. I am aware that this view is not that of a practical engineer, but neither is it that of an illusionist, for it is certain that power transmission, which at present is merely a stimulous to enterprise, will some day be a dire necessity.

It is more important for the student who takes up the study of light phenomena to make himself thoroughly acquainted with certain modern views, than to peruse entire books on the subject of light itself, as disconnected from these views. Were I, therefore, to make these demonstrations before students seeking information—and for the sake of the few of those who may be present, give me leave to so assume—it would be my principal endeavor to impress these views upon their minds in this series of experiments.

It might be sufficient for this purpose to perform a simple and well known experiment. I might take a familiar appliance, a Leyden jar, charge it from a frictional machine, and then discharge it. In explaining to you its permanent state when charged, and its transitory condition when discharging, calling your attention to the forces which enter into play and to the various phenomena they produce, and pointing out the relation of the forces and phenomena, I might fully succeed in illustrating that modern idea. No doubt, to the thinker, this simple experiment would appeal as much as the most magnificent display. But this is to be an experimental demonstration, and one which should possess, besides instructive, also entertaining features, and, as such, a simple experiment, such as the one cited, would not go very far toward the attainment of the lecturer's aim. I must, therefore, choose another way of illustrating, more spectacular, certainly, but perhaps also more instructive. Instead of the frictional machine and Leyden jar I shall avail myself in these experiments of an induction coil of peculiar properties, which was described in detail by me in a lecture before the London Institution of Electric Engineers, in February, 1892. This induction coil is capable of yielding currents of enormous potential differences, alternating with extreme rapidity. With this apparatus I shall endeavor to show you three distinct classes of effects, or phenomena, and it is my desire that each experiment, while serving for the purposes of illustration, should, at the same time, teach us some novel truth, or show us some novel aspect of this fascinating science. But before doing this it seems proper and useful to dwell upon the apparatus employed, and method of obtaining the high potentials and high frequency currents which are made use of in these experiments.

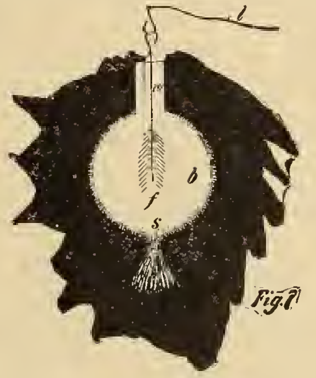

Fig. 7

Breaking a Bulb on Open Circuit.

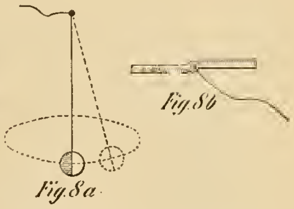

Fig. 8b

Fig. 8a

Mechanical Motions Produced by Varying Electrostatic Force in a Gaseous Medium.

ON THE APPARATUS AND METHOD OF CONVERSION.

These high frequency currents are obtained in a peculiar manner. The method employed was advanced by me about two years ago in an experimental lecture before the American Institute of Electrical Engineers. A number of ways, as practiced in the laboratory, of obtaining these currents, either from continuous or low frequency alternating currents, is diagrammatically indicated in Fig. 1, which will be later described in detail. The general plan is to charge condensers, from a direct or alternate current source, preferable of high tension, and to discharge them disruptively while observing well known conditions necessary to maintain the oscillations of the current. In view of the general interest taken in high frequency currents and effects producible by them, it seems to me advisable to dwell at some length upon this method of conversion. In order to give you a clear idea of the action, I will suppose that a continuous current generator is employed, which is often very convenient. It is desirable that the generator should possess such high tension as to be able to break through a small air space. If this is not the case, then auxiliary means have to be resorted to, some of which will be indicated subsequently. When the condensers are charged to a certain potential, the air, or insulating space, gives way and a disruptive discharge occurs. There is then a sudden rush of current, and generally a large portion of the accumulated electrical energy spends itself. The condensers are thereupon quickly charged, and the same process is repeated in more or less rapid succession. To produce such sudden rushes of current it is necessary to observe certain conditions. If the rate at which the condensers are discharged is the same as that at which they are charged, then, clearly, in the assumed case the condensers do not come into play. If the rate of discharge be smaller than the rate of charging, then, again, the condensers cannot play an important part. But if, on the contrary, the rate of discharging is greater than that of charging, then a succession of rushes of current is obtained. It is evident that, if the rate at which the energy is being dissipated by the discharge is very much greater than the rate of supply to the condensers, the sudden rushes will be comparatively few, with long time intervals between. This always occurs when a condenser of considerable capacity is charged by means of a comparatively small machine. If the rates of supply and dissipation are not widely different, then the rushes of current will be in quicker succession, and this the more, the more nearly equal both the rates are until natural limitations incident to each case and depending upon a number of causes are reached. Thus we are able to obtain from a continuous-current generator as rapid a succession of discharges as we like. Of course, the higher the tension of the generator, the smaller need be the capacity of the condensers, and for this reason, principally, it is of advantage to employ a generator of very high tension. Besides, such a generator permits the attaining of greater rates of vibration.

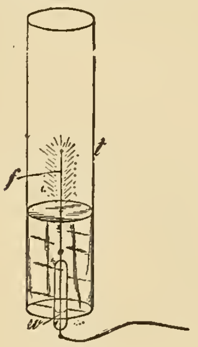

Fig. 9

SHOWING THE EFFECT OF THE AIR.

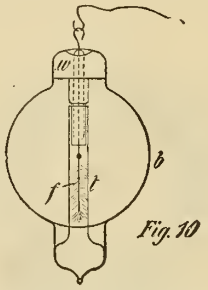

Fig. 10

SHOWING THE INFLUENCE OF THE CONDUCTIVITY OF THE MEDIUM UPON ELECTROSTATIC ACTIONS THROUGH MEASURABLE DISTANCE.

The rushes of current may be of the same direction under the conditions before assumed, but most generally there is an oscillation superimposed upon the fundamental vibration of the current. When the conditions are so determined that there are no oscillations, the current impulses are unidirectional and thus a means is provided of transforming a continuous current of high tension into a direct current of lower tension, which I think may find employment in the arts.

This method of conversion is exceedingly interesting and I was much impressed by its beauty when I first conceived it. It is ideal in certain respects. It involves the employment of no mechanical devices of any kind, and it allows of obtaining currents of any desired frequency from an ordinary circuit, direct or alternating. The frequency of the fundamental discharges depending on the relative rates of supply and dissipation can be readily varied within wide limits by simple adjustments of these quantities, and the frequency of the superimposed vibration by the determination of the capacity, self-induction and resistance of the circuit. The potential of the currents, again, may be raised as high as any insulation is capable of withstanding safely by combining capacity and self-induction or by induction in a secondary, which need have but comparative few turns.

As the conditions are often such that the intermittance or oscillation does not readily establish itself, especially when a direct current source is employed, it is of advantage to associate an interrupter with the arc, and I have, some time ago, indicated the use of an air-blast or magnet, or other such device readily at hand. The magnet is employed with special advantage in the conversion of direct currents, as it is then very effective. If the primary source is an alternate current generator, it is desirable, as I have stated on another occasion, that the frequency should be low, and that the currents forming the arc be large, in order to render the magnet more effective.

(To be Continued.)

LEGAL DECISIONS.

At Sherbrooke, Que., on August 18th last, in the case of C. A. Bissett, representing the Bell Telephone Co., vs C. Skinner *et al.*, representing the Sherbrooke Telephone Association, in which the defendants were charged with wilfully cutting telephone wires, the property of the plaintiffs', Judge Rioux gave judgment as follows:—

The defendants are charged with having wilfully cut eight wires of the Bell Telephone Company in Sherbrooke. The complaint is laid under Article 492 of the Criminal Code.

The facts proved at the Enquete show that the Bell Company had a line of poles on the north side of King street, existing there for several years, and located under the direction of a municipal officer, which poles supported a number of wires forming a part of their telephone system.

That about the twentieth of July last, Mr. Lemay an employee of the Bell Company put up more wires on these poles for the service of the company and before his work was completed on the 28th, one of the defendants, Pelletier, was instructed by the defendant, Skinner, under whom he works, to cut the wires of the Bell Company, and it was done: eight wires were cut.

It was claimed on the part of the defendants that these wires interfered with those of their company, and that they were justified in cutting them, at least, such appears to be the line of defence of the accused, from the cross examination of the witnesses.

It is shown that the lines of the two companies intersect each other on this street, near the Continental Hotel, and that is the point where the Bell lines were cut. The lines of the Bell Company were lotated on the poles above those of the Association, and in the space allotted by the charter of the company, viz., 22 feet from the ground.

By the Quebec Statutes of 1881, C. 76, power and authority were given this company to erect poles and construct lines of telephone under certain restrictions and regulations of the municipal officers. It is shown by the evidence of the men who worked in putting up these wires that they were of a sufficient height above the point of intersection with those of the Association, so as not to interfere with their wires in any way; and it is to be presumed, that if they touched them afterwards, it must have been caused by the Association having tightened their own wires, therefore causing them to raise, and come in contact with the Bell wires.

Whatever might have been the cause of the collision of the wires of the two companies, one thing appears to me certain, that is, the Bell Company, in this instance, were acting within their rights, in putting up these wires in the space allotted to them by the Statute, and as long as they remained within those strict rights, they should not have been interfered with by any other, without showing some authority to do so. I do not want to be understood to say, that the Bell Company has privileges in the City which another company cannot acquire by getting the proper act of organization, but what I do say is, that at present the Bell Company is the only company which has obtained the proper authority from the Legislature to construct their telephone system.

This is apparent by reading the report of the case, of the City versus The Sherbrooke Telephone Association, in the 19th volume of the *Revue Legale* page 538.

The Association in this present case have not shown, or ever attempted to show what rights they had, to put up wires and interfere with privileges obtained by their rivals—no Letters Patent, still less in any Statute, produced here, before me, to show their legal existence, so that in reality I am forced to decide between the rights of an Incorporated Company, shown to be such by Statute, and those of two persons (accused) who claim to act for another incorporated body, but whose legal existence is not proved, or even attempted to be proved. In the face of this, I cannot hesitate to find the proof sufficient to warrant me in sending the accused before the Court of Queen's Bench for their trial.

At the argument, the defendents have urged very strongly, (and it was even urged by them, that this was, in fact, the only point in the case,) that it was not proved by the prosecution that the wires cut were in active operation, but on the contrary were dead wires. I consider this objection futile, and the reading of Article 492 of the Criminal Code warrants no such interpretation, " Every one is guilty of an indictable offence who wilfully . . . destroys, removes or damages anything which forms part of . . . any telephone, etc. . . ." Can it be said, that because these wires were not yet connected with electric batteries, that they did not form part of the company's telephone system, and consequently any one had a right to cut them? It would be an outrage to reason, to argue so, as it would afford an easy way to a rival company to prevent competition by destroying the wires, as soon as they are put up, and before they are connected.

With regard to the proof of this cutting, having been done wilfully, there cannot be any doubt, according to the evidence, and according to the definition of this word by Art. 481.

In conclusion I may say, that whatever rights the Sherbrooke Telephone Association may show to have in this matter hereafter before another court, it is difficult to believe that they could take the law in their own hands, and be relieved of all responsibility of their actions.

SPARKS.

The electrical apparatus designed by Mr. Thomas Munroe, C. E., for operating the lock gates of the Beauharnois canal, has undergone satisfactory tests.

It is reported that the stock of the Galt and Preston Electric Street Railway Company is being rapidly taken up, and that the work of construction will shortly commence.

The Royal Electric Company has offered to establish works and give employment to 300 men at Cote St. Louis, on condition that the municipality will grant a bonus of $30,000.

The Guelph Light and power Company will hereafter furnish an all-night service at the request of their customers. Their incandescent lighting business is said to be rapidly increasing.

It is said that the Calgary Electric Lighting and Heating Company have been given the contract for lighting the streets of that city, and that their price for the work is the lowest in Canada.

Well deserved praise is being bestowed upon Mr. Brothers, the new superintendent of construction of the Montreal Street Railway, for the rapidity with which, under his direction, construction is being carried on.

There has reached us on the eve of going to press a kind invitation from Mr. Eugene F. Phillips to attend the fifteenth annual Rhode Island Clam Dinner tendered to the electrical fraternity by the American Electrical Works. The dinner will take place at Haute Rieve on Saturday next the 2nd inst., and we doubt not will prove quite as enjoyable as its predecessors.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of the various Associations are requested to forward us matter or publication in this Department not later than the 20th of each month.

THE FOURTH ANNUAL CONVENTION.

THE following programme of proceedings has been arranged for the Fourth Annual Convention of the Canadian Association of Stationary Engineers, to be held in Montreal on Thursday, Friday and Saturday, the 7th, 8th and 9th inst.

THURSDAY, SEPT. 7TH.

7.30 a.m.—Reception of delegates at G. T. R. depot; escort to City Hotel for breakfast.

10 a.m.—Opening session at Engineers' Hall. Call to order. Address of Welcome by District-Deputy, Bro. Thos. Ryan. Appointing Committee on Credentials. Short recess Report of Committee on Credentials. President's opening address. Reading minutes of last meeting. Secretary's Annual Report. Treasurer's Annual Report. Reports of Standing Committees. Appointing of Auditors. Appointing Committees on Constitution, Correspondence, Good of the Order.

2 p.m.—Auditors' Report. Drive round the city and to the mountain top; then to the Exhibition by way of the cemetery. Lunch tendered by the directors of the Montreal Exposition Co.

7.30 p.m.—Open meeting. The public are cordially invited. Paper on "Waste Heat," by Bro. A. M. Wickens. Paper on "The Duties of Engineers Twenty Years Ago as Compared with the Present Day," by Bro. Chas. Kinsey.

FRIDAY, SEPT. 8TH.

10 a.m.—General Business.

AFTERNOON SESSION.

2.30 p.m.—Good of the Order. Adjourn at 4.15 to G. T. R. depot for Lachine, and home by the Rapids.

8.30 p.m.—Banquet.

SATURDAY, SEPT. 9TH.

10 a.m.—Election of Officers. Selection of next place of meeting.

2.30 p.m.—Paper on "Electric Motors," by Mr. W. B. Shaw. Paper on "Heating and Ventilation of Factories," by Bro. John J. York. Adjournment.

MONTREAL NO. 1.

At a recent meeting of the above Association, Brother Geo. Hunt, on behalf of Mr. G. W. Ingils, presented the Association with a valuable model of the Blake steam pump, and a complete set of blue prints, handsomely framed, of a 12,000,000 gallon Blake compound pumping engine. The members of the Association were enthusiastic in their appreciation of the valuable gift. A vote of thanks was passed to Mr. Ingils, who was also elected an honorary member. At the same meeting several large photographs of the Babcock-Wilcox boiler were presented to the Association by Mr. A. H. Holden. The photographs were expensively framed. A hearty vote of thanks was tendered to the donor.

TORONTO, NO. 1.

The above Association held their regular meeting on Aug. 11th, with President Wilson Phillips in the chair. One member was initiated and an application for membership received. Under the head of "Good of the Order," the following questions were answered and illustrated on the blackboard by past-President Bro. Blackgrove:

(1). What would be the difference in percentage of strength of joint as compared with solid plate in the following joints: First, thickness of plate, 5-16″; diameter of rivet, ⅝″; pitch, 2.27″? Answer, 72%. Second, thickness of plate, 5-16″; diameter of rivet, 11-16″; pitch, 2.29″? Answer, 69.97%.

(2). Is there any advantage in making girth seams double rivetted? Answer, no!

(3). Is there any advantage in securing the flange of a dome by double rivetted joints? Answer, no!

(4). What size of boiler should be put in to heat a building containing 300,000 cubic feet of space and run a 10 h.p. engine? Answer, 30 h.p.

(5). What would be the safe working pressure of a boiler 60″ diameter, 5-16″ plate, joints same as first question above, 60,000 lbs. tensile strength Dalizell steel? Answer, 125 lbs. to the square inch.

On August 25th, the usual meeting was held, with Vice-President Butler in the chair. Two members were initiated and an application for membership received. The two alternate delegates, Bros. Sutton and Gilchrist, were asked to fill the places of Bros. Lewis and Phillips, who cannot attend the Convention of Engineers to be held in Montreal.

After the ordinary business was disposed of, a long discussion took place on questions that are expected to come before the Engineers' Convention, and final instructions were given to the delegates who are appointed to represent the Association.

CHAS. F. KINSEY,
Cor. Secretary.

NOTES FOR ENGINEERS.

STEAM boilers should have two safety valves, each one capable of discharging all the steam which the boiler can produce at the pressure to be controlled by the safety valves. The object of having two, is to diminish the risk of failure to act when the pressure rises. With only one valve, should that one stick to its seat, or fail in any other way, the boilers would be left without any protection from undue rise of pressure. It is not uncommon to have the one valve loaded so as to open at about 5 lbs. higher pressure than the other one. If the first one opens at 80 lbs. the other should open at 85 lbs. By this arrangement the action of each valve can be observed by the engineer with greater accuracy than if both opened at the same time. The higher the pressure, the smaller the valve needed to relieve the boiler. The steam making capacity of the boiler is dependent upon the size of furnace and amount of heating surface, but as all the heat comes from the furnace it is usual to make the area of the safety valve a definite proportion of the fire grate. For 60 lbs. pressure, the safety valve should open one half a square inch for each square foot of fire grate. For lower pressure the safety valve should be higher, and for higher pressure it may be smaller.

* * *

Scale and deposit forming inside of steam boilers are the cause of much anxiety to the engineer and may cause very serious loss of fuel. By scale is meant the hard formation usually of lime which adheres to the parts of the boiler in contact with the water. By deposit is usually meant the accumulation of sand or mud, or broken pieces of scale. A uniform deposit of scale is not nearly so dangerous as an accumulation of mud or sand. Nearly all water used to feed steam boilers contain lime or sand or some other admixture. When steam is formed and taken off, these impurities are left behind and gradually accumulate inside. A 50 H.P. boiler would use at least 9000 gallons of water in a week of 60 hours. If in each ten gallons of water there were half an ounce of solid matter, in a week's run as much as 28 lbs. weight would be left in the boiler. If this were to accumulate on the bottom or where the strong heat of the furnace was applied to the plates, they would soon become overheated, and be burned or buckled out of shape. To prevent this, the blow off cocks should be opened every day and the boiler should be opened and washed out at least once a month.

* * *

There are many different ways of firing steam boilers and each has its advocates who claim their method to be the best. The truth seems to be that as coal varies in quality, so must its treatment during combustion be varied, and what is best for one kind of coal will produce very poor results with other kinds. As a general rule, when the best results possible from a boiler are required, and the greatest amount of steam is wanted, the coal should be spread uniformly over the grate, and kept of an equal thickness throughout. The thickness may vary from about 5 inches to about 10 inches, and usually it will be found that a thin fire will give the best results, and requires most attention. If the coal is found to melt and to seal the bars, so that sufficient air does not get through, it will be an advantage, to shove the fire back on the grate and put the fresh coal in a heap on the front of the grate, where it will be coked and should then be shoved back and a fresh supply put on. The method of coking will be found the most economical way of burning coal, provided the boiler be large enough. Spreading the coal evenly makes the most out of the boiler. Coking the coal and then spreading it makes the most out of the fuel. When troubled with clinkers forming either on the grate bars, or on the sides of the furnace, keep a little water in the ash pit. This will be found to preserve the grate bars and prevent them from warping and will soften and break the clinkers, so that they can be easily removed.

* * *

To wash a boiler out properly, have it as cool as possible before beginning. If it is surrounded with brickwork get it cooled down. Open the blow off cock and blow out a little under pressure, so as to make sure that cock and pipes are clean. Then, when steam is down fill boiler entirely full of water. This can be done by having connection with water works mains, or with an over-head tank. Then with man hole cover off, and blow off cock open, wash out from above, using plenty of water, and as much pressure with it can be got. After that, remove the hand holes and scrape the bottom. The boiler should be kept wet inside all the time and not allowed to dry. Where there is much scale, it may be necessary to stop the water, and have a man go inside and break the scale off; but if a boiler is always washed out from the man hole and kept wet inside during the cleaning out, there will not be much scale to break off.

Every member of the C. E. A. who may come to Toronto on the 12th, 13th and 14th inst., will witness the best Electrical Convention and the greatest Industrial Exhibition ever held in Canada, the most interesting Electric Railway, the greatest source of Power and the greatest engineering scheme for the utilization of that power to be found in the world, and at the least possible cost. Will you take it in?

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Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 25th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 22nd day of the month.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free. for $1.00 per annum, 50 cents for six months. The price of subscription may be remitted by currency, in registered letter, or by postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters must be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union, $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. *When ordering change, always give the old as well as the new address.*

The Publisher should be notified of the failure of subscribers to receive their papers promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

THE "CANADIAN ELECTRICAL NEWS" HAS BEEN APPOINTED THE OFFICIAL PAPER OF THE CANADIAN ELECTRICAL ASSOCIATION.

CANADIAN ELECTRICAL ASSOCIATION.

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Information regarding examinations will be furnished on application to any member of the Board.

THE unsettled state of business in the United States has had a depressing effect on the mica mining industry in the Ottawa district. In this connection we are pleased to notice that Dr. Selwyn, director of the Geological Survey, emphatically denies the published statement to which we referred in our last issue, that the exhibits of Canadian mica at the Columbian Exposition were much inferior to those of India and Australia. Dr. Selwyn declares that Canada has by far the best exhibit of mica at the Fair, and that the only crystals exhibited are those from Canada.

A COMMITTEE of the municipal council of the city of Glasgow has recommended that the telephone business be conducted in future by the municipality instead of by the National Telephone Co., as heretofore. The latter company, in a statement published in a Glasgow paper, points out the injustice which would result from taxing a population of 700,000 people in order to slightly reduce the cost of service to a few thousand telephone users. Municipalization has already been adopted in an extensive degree in Glasgow, the waterworks, gas, electric light and tramway systems being already under civic control.

IN Ottawa the electric cars are being utilized to carry the mails to the railway depots. This will no doubt prove to be but one of numerous uses which electric cars will eventually be made to serve. It has been proposed to utilize cars built for the purpose to convey during the night the sweepings and other refuse from city streets. The question of cost is of course one of prime moment. Should it be found as inexpensive to employ electric cars as horses and carts, the former may at an early date be expected to supersede the latter. It may be regarded as certain that the possibilities of the electric railroad will be found not to be limited to the business of carrying passengers.

In the present issue will be found the first instalment of Mr. Nikola Tesla's remarkable lecture on "Light and Other High Frequency Phenomena," delivered before the Franklin Institute and the National Electric Light Association of the United States. The publication of this lecture, which is accompanied by numerous illustrations, will probably extend over three successive issues of THE NEWS. In this lecture Mr. Tesla has demonstrated several new and startling theories with regard to the character, and operation of electric currents, and has indicated future developments on the line of their application to practical uses, the fulfilment of which would be but slightly less wonderful than what has already taken place. Mr. Tesla is regarded as perhaps the ablest and most original experimenter in the field of electricity at the present time, and the most likely source from which future discoveries may be expected to emanate. Every student of electricity should therefore study and seek to thoroughly understand the theories and facts set forth in the lecture which we publish, and carefully preserve the copies of THE NEWS containing the same for future reference.

WE wish to call the attention of our correspondents to the fact that the name and address of the writer must accompany every communication in order to insure its insertion. This is a well known journalistic rule, and one which is necessary for the protection of the publisher. Some of our correspondents in asking for information have overlooked this requirement. Apparently they have omitted their name because they did not wish it to appear in print. To such we may say that although the name is required by the publisher for his protection, it does not follow that the same will be printed with the communication. The correspondence may appear over a *nom de plume* if so desired but the actual name and address of the author must be in the editor's possession.

MOST engineers of experience will recognize the truth of the following from the columns of the *Canadian Manufacturer*: It may seem strange to the uninitiated, but it is a fact well known to those who have been through the mill, that owners of steam boilers do not always encourage their engineers to report defects in them, but on the contrary try to bulldoze them into silence on the subject, by threatening them with a loss of their situation, and it sometimes does happen that a man is discharged for reporting such defects, or leaves the place because he cannot have them repaired, in which case there is always some reckless ignoramus ready to take the chances of disaster by keeping it in operation, and there is always someone willing to recommend him for the situation. Let us have laws passed requiring manufacturers to take out licenses permitting them to own steam boilers after they have proved themselves to be fit persons to own such property for they are needed as much as license laws for engineers are, and perhaps more.

IN the August number of THE NEWS a correspondent asked for information regarding the means and cost of obtaining an engineer's certificate. For the information of this correspondent and of others of our readers who may desire it, we now amplify somewhat the answer which we published in last issue, on the above subject. First of all it should be said that there are two associations of Canadian engineers, viz., the Canadian Association of Stationary Engineers and the Ontario Association of Stationary Engineers. The C. A. S. E. is an educational society and does not grant certificates. The O. A. S. E. have the power to grant certificates under an Act passed by the Ontario Legislature, April 30th, 1891. The cost of these certificates, as before stated, is as follows: for a 1st class, $5.00; 2nd class, $3.00; 3rd class, $2.00. The certificates are to be renewed at the end of each year. The price of renewal is, for a 1st class, $1.50; 2nd class, $1.25; 3rd class, $1.00. If a certificate holder gets intoxicated, or through carelessness breaks his engine, the Board of Examiners will refuse to renew his certificate. The persons wishing to obtain a certificate should write to the Registrar of the Association or to the member of the Board of Examiners residing nearest to his locality, who will make the necessary arrangements for his examination. There is no stated place or time fixed for such examination, but the convenience of the applicant is consulted in these particulars. The names of the officers of the association and of the Board of Examiners are given in each issue of THE NEWS. If a candidate applies for a first-class certificate and fails to pass the required examination, the price of a first class certificate is put to his credit, and he may come up for examination again as often as is necessary without extra charge until he secures his certificate. To become a member of the C. A. S. E., the applicant must pass an examination or present a certificate from the O. A. S. E., which will be accepted in lieu of an examination. The initiation fee is $3.00, and the dues 30 cents per month. It is not a labor organization but an educational society, and has proved most helpful to its members, many of whom are now holding good positions as the result of the knowledge gained at its meetings.

The Electrical Industry is rapidly assuming a position of great importance in Canada. The Canadian Electrical Association seeks to promote its progress and conserve its welfare, and is consequently deserving of the support of every person connected with or interested in electrical matters. All such persons are invited to be present at the Convention on the 12th, 13th and 14th inst.

CANADIAN ELECTRICAL ASSOCIATION.

BELOW will be found printed the programme of the Third Convention of the above Association, to be held on the Toronto Industrial Exhibition Association's grounds, on Tuesday, Wednesday and Thursday, the 12th, 13th and 14th inst. The papers are now in the hands of the Secretary, and copies of them are being printed. These printed copies will be placed in the hands of members at the Convention prior to being read by the authors, thus affording opportunity for intelligent discussion. Applications for membership are coming in, and all the indications point to a well attended and interesting meeting. The programme is as follows:

TUESDAY, SEPT. 12TH.

2 p.m.—President's Address.
Secretary-Treasurer's Report.
Report of Committees.
General Business.
Paper by Mr. Fred. C. Robertson, Toronto. Subject: "Some of the Causes of Interruption to Telegraph Circuits."
Paper by Mr. A. C. McCallum, of Peterboro'. Subject: "Water Wheels."

WEDNESDAY, SEPT. 13TH

10 a.m.—Nomination and Election of Officers, and selection of place of next meeting.
Unfinished Business.
Paper by Mr. L. B. McFarlane, of Montreal. Subject: "The History of the Telephone in Canada."
Paper by Mr. E. B. Merrill, Toronto. Subject: "Electrical Education."
Paper by Mr. John Langton, Toronto. Subject: "Direct Connected Dynamos and Steam Engines."
Paper by Mr. E. Carl Breithaupt, of Berlin, Ont. Subject: "Electric Street Railways."

THURSDAY, SEPT. 14TH

7 a.m.—Steamer of Niagara Navigation Company to Queenston.

By courtesy of Mr. W. A. Grant, Manager, a special car will be taken on the Niagara Falls Park and River Electric Railway from Queenston to Chippewa, and inspection made of the power house and plant.

Also by invitation of Capt. Carter, the members will visit the Falls at Table Rock and Prospect Park, the works in the Tunnel District, the Tower, etc., and take a trip around the Falls on the Steamer "Maid of the Mist." Luncheon will be provided at the Cliff House, and dinner on the boat during the return trip.

Members of the Association in good standing will receive tickets covering the above, without cost to themselves, upon application to the Secretary. Ladies' tickets may also be obtained by members for $1.50 each.

PERSONAL.

Mr. C. W. Hurlburt, formerly with the G. N. W. Telegraph Company, Montreal, has been appointed to succeed Mr. A. Bennett as editor of telegraphic dispatches at Toronto.

Professor Caius-Wilson, of the electrical engineering department of McGill University, is about to be married in England to Miss Mary Louisa Georgina Petrie, B.A., of Hanover Lodge, Kensington Park.

We learn that Mr. Fred. Thomson has severed his connection as electrician with the Royal Electric Company, of Montreal. Mr. Thomson is at present visiting the World's Fair. It has not been learned what his future course of action is to be.

Mr. A. C. McCallum, of Peterboro', whose paper on "Water Wheels" forms a feature of the programme of the approaching C. E. A. convention, has recently become a Benedict. THE ELECTRICAL NEWS extends to Mr. and Mrs. McCallum its best wishes for a long and prosperous matrimonial voyage.

Mr. Fred G. Mitchell, of London, has been appointed inspector for the Boiler Inspection and Insurance Co., of Toronto. We doubt not he will prove himself well qualified for the position. Mr. Mitchell is one of the most active members of the C. A. S. E. in London, and as such will be greatly missed.

THE ELECTRICAL NEWS received a visit recently from Mr. W. A. Turbayne, electrician of the Turbayne Tamblyn Company, of Detroit, Mich., manufacturers of arc lamps and electrical specialties. Mr. Turbayne, who was formerly a resident of Toronto, states that his company may possibly establish an agency in Canada.

Mr. R. A. Ross, electrical engineer, and Mr. C. Legrand, tester, have severed their connection with the Canadian General Electric Company's Works at Peterboro', and were tendered a farewell supper by their associates on the eve of their departure. Mr. Ross has accepted a position with the Royal Electric Company, Montreal.

For some time past Mr. Wm. Wylie, assistant manager of the City and Suburban Street Railway, Toronto, has been in a critical condition of health as the result of blood poisoning, due to having scratched his finger with a rusty nail. At times he was unconscious and but slight hopes were entertained of his recovery. We are pleased to learn, however, that he is now considered to be out of danger.

It is with much regret that we learn of the retirement of Mr. Dan. Thomson from the management of the Hamilton Electric Light and Power Company. The change is due to the unprofitable condition of the Company's business, which has rendered necessary an attempt to curtail expenses. In common with Mr. Thomson's many friends we shall be pleased if an opening presents itself in Canada for his services. He is undoubtedly one of the most capable electricians in this country, and should if possible be retained here.

QUESTIONS AND ANSWERS.

R. S. M., writes: How many "watt hours should seven incandescent lamps of 16 c. p. consume per hour, and does the current passing from one lamp, effect a meter proportionately to the 6 others not burning? To explain why I ask the question I may say that I have recently occupied a store fitted with eledtric lamps (7) as above described, and in two weeks have used 9000 watt hours. The actual time of burning was not more than 18 hours, and I concluded that the meter must be at fault, or that the charges in comparison to lamp per month were excessive. I would like if you could give me the rates that are charged in oteer places where meters are used.

ANS: The kind of lamp used would affect to a considerable extent the number of watts of current consumed per hour; the average however, is about 60 for a 16 c. p. lamp. The meter if a good one, should measure one lamp justly as exactly as seven. Of course an increase in the voltage, from any cause, would tend to increase the brillancy of the light, and consequently the number of watts registered; but with a constant voltage, the consumption of current should be recorded exactly, with any load. Some lamps are more economical than others, and this may have something to do with the matter, The rates for current supplied by watt meter, range from 13 to 20 cents per 1,000 watts. The usual price is about 15 or 16 cents with a small discount for cash payment.

AN Ottawa correspondent asks: (1.) Is there a rule to find the temperature of steam at any pressure?

ANS: The general result of experiments shows that the pressure increases as the temperature is increased, but the incsease is not uniform. At 212° the pressure is 14·7 lbs., and the rise of pressure is about 29 lbs. for each degree of temperature At 300° the pressure is 67·22 lbs., and each degree of temperature adds 1 lb. to the pressure. Many formulæ have been proposed to show this, but for all practical purposes it is much better to use some one of the published tables found in Engineering works, giving the relative properties of saturated steam. One of the simplest formulæ, suggested by Mr. W. M. Buchanan, and used by Dr. K. Clark, is as follows:

$$t = \frac{2938.16}{6.1993544 - \log p} = 371.85.$$

where t = the temperature in degrees Fah. and p = pounds per sq. inch.

(2.) How to find the relative volume of steam at different pressures?

ANS: There have been very few reliable experiments made to determine this relation. The most reliable were made more than 30 years ago and published in a paper read by Sir Wm. Fairbairn before the Royal Society in 1860. The formulæ given by Fnirbairn is:

$$v = .41 + \frac{389}{p + .35}.$$

where v = volume in cubic feet.
and p = pounds per sq. inch.

(3.) How to find the total heat of steam at any pressure?

ANS: The total heat of saturated steam is the sum of its latent and sensible heat, and it is usual to assume that the steam is produced from water of 32° Fah. The total heat then, represents the amount of heat which has been added to water of 32° in order to produce steam of the pressure given. First find the temperature corresponding to the pressure, then let
t = the temperature.
h = the total heat.
$h = 1081.4 + .305\,t.$

(4.) How to find the velocity of draught from inches of water?

ANS: Velocity of draught may be measured by inches of water indicating the difference of pressure which is causing the draught.

An approximate formulæ is: $v = vp \times 102.$
That is, the velocity of draught in feet per second is equal to the sqare root of pressure in inches of water multiplied by 102.

MONTREAL ELECTRIC CLUB.

AN informal meeting of some of the officers of the above Club was held at the residence of J. A. Farlinger on Wednesday night last, at which it was decided, owing to the success of the Club last year, that it be called together again. The first meeting will take place at the old rooms, usual hour, on Monday, Sept. 11th.

It is the intention of the Club to have an exhibition of apparatus, added to the items for each evening, which will no doubt prove an interesting adjunct to the proceedings.

New by-laws will be drafted the coming winter, and new regulations regarding admitting new members, so as to give the Club a wider scope, at the same time keeping it strictly within electrical bounds.

Many new applicants are expected, and the Club look for a successful winter session.

Will Niagara Falls be your objective point on the 14th inst.?

CORRECTION.

Ed tor ELECTRICAL NEWS.

DEAR SIR:—I have noticed the following item in the August issue of the CANADIAN ELECTRICAL NEWS:

"Owing to the trouble that has been experienced by the Toronto Street Railway with the Edison motors heretofore in use, the manager has decided to replace them with Westinghouse motors at a cost of about $50,000."

I beg to inform you that your information is quite incorrect as we are not replacing the Edison motors and have recently awarded the Canadian General Electric Company a contract for one hundred Thomson-Houston W.P. 50 motors,

Yours truly,
WM. MCKENZIE,
President Toronto Railway Company.

DANGEROUS STEAM PLANTS.

Editor CANADIAN ELECTRICAL NEWS.

SIR,—A short time ago, I had occasion, while waiting for a train, to spend some time at a station west of London on the G. T. R. As usual I commenced to look around me for smoke stacks, and finally located three; and not far away either. I made my way to one place which turned out to be a flour mill, and on entering found a gentleman, who turned out to be proprietor, miller, book-keeper and engineer of the establishment. After some conversation, I expressed a wish to see the steam plant, and was conducted to the engine room. On arriving there I found an old slide valve engine hammering away. The flange joints of steam pipe and steam chest cover were packed with pieces of shingles. The result was a sound resembling that produced by some of our city fife-and-drum bands at the 12th of July period. I noticed water and steam flying out of something at the front of the boiler, and upon investigating more closely, found a 1½" blow-off cock on a pipe; instead of the brass plug being in the cock, there was a wooden plug driven in, and this was what was leaking. I looked up at the steam gauge and saw that it registered 70 lbs. I suddenly took a notion to go up stairs, and advised the "engineer" on my way up, to put on a new blow-off cock, but he said it was all right, and he wasn't afraid. He also told me that the old boiler in this mill exploded a few years ago and killed the engineer and blew the end of the mill down. I advised him to be careful, or the new boiler might scald him some day.

I afterwards saw the remains of the boiler which exploded near Petrolea a short time ago, killing the engineer and a machinist who was repairing the engine. I believe if this boiler had been inspected that it would have been condemned long before the time of the explosion, and two lives would have been saved.

Yours, &c.,
TRAMP.

TRADE NOTES.

The Penberthy Injector Company of Detroit, have issued the first number of the "Penberthy Bulletin," which is devoted to information regarding their appliances.

Messrs. Darling Bros., of Montreal, have issued in pamphlet form a list of Morse Valve Machines sold by them in Canada, and also a number of excellent testimonials from purchasers who have given them a thorough and satisfactory trial.

The Royal Electric Co. have lately shipped to Pueblo Principe, Cuba, two 750 light alternators, with the necessary station apparatus, transformers, lamps, etc. This is claimed to be the first shipment to foreign parts of Canadian manufactured electrical machinery.

The Royal Electric Company of Montreal, have purchased from the Robb Armstrong Company of Amherst, N. S., a 75 h. p. Monarch Economic boiler and a Robb Armstrong automatic engine, to be used in the operation of the electric light plant at Montreal Junction.

The Magnolia Metal Company, which sells its metals all over the world, extends to its friends an invitation to visit its exhibit at the World's Fair; it can be found at Section No. 10, Column No. E-53, where all people who are interested in the running of machinery with the least amount of friction are welcome.

The Dodge Wood Split Pulley Company, of Toronto, have recently equipped with their well known split pulleys, the Rathbun Company's mill at Campbellton, Ont., the Waterloo Woollen Company's mill, at Waterloo, Ont., J. & J. Black's mill at Thurso, Que., and Geo. Matthews Packing Company's establishment at Peterboro'.

Mr. T. W. Ness, manufacturer and dealer in electrical supplies, 249 Craig street, Montreal, has found it necessary to enlarge his buisness, and with this object has taken into partnership Messrs. P. H. Davidson, J. E. Adams, James L. Rakin and N. W. McLaren. Mr. Davidson for a number of years past had charge of the books, in the old firm. Mr. Rakin was formerly interested in real estate, and Mr. McLaren was proprietor of the Montreal Sign Works. The new members will bring with them into the Company new capital, and are known to be active workers, so that the business may be expected to steadily increase.

We learn that Messrs. Ahearn & Soper, of Ottawa, are making a specialty of low-period, two-phase machines, such as are supplying current for all the incandescent lighting at the Chicago Exposition. These machines are 15,000 light capacity each, and of periodicity of 50 per second. They are operating incandescent, arc light and two-phase A. C. motors from the same circuit. Messrs. Ahearn & Soper are now offering a full line of slow speed low-period alternators, for example, a 1,200 light machine has a speed of only 600 revolutions, a 900 light machine runs at 720 and a 600 light machine at 900. Being low-period it is possible to run both arc and incandescent lights with the same degree of ease. The armatures are removable.

The St. Clair Tunnel Company are receiving estimates for the electrical equipment of their line through the tunnel, with the object of avoiding the smoke from the locomotives, which is having an injurious effect upon the tunnel.

THE INTERNATIONAL ELECTRICAL CONGRESS.

By E. B. Merrill.

On Monday the 21st of August and the four succeeding days, there met in Chicago an International Electrical Congress which is likely to form a landmark amongst such meetings for many years to come. It was composed of electrical men from nearly all the civilized countries of the world and contained an inner circle known as the "Chamber of Delegates," which consisted of those specially designated by the various governments to represent them, and whose business it was to consider the adoption of electrical notation and standards and the definition of units with a view to recommending the legalizing of the same.

The Congress met in the Art Institute where other engineering or scientific congresses had also been held or were then in progress. The choice of the building was rather unfortunate for such important work, as it is located on the lake front and immediately behind it, between it and the lake, are a large number of tracks of the Illinois Central, so that during the whole course of the meetings there were continual interruptions from the puffing and hissing of the locomotives and the rumbling and rattling of the trains rushing through or being shunted here. It taxed to the utmost the vocal powers of those that read papers or took part in the discussions, and was often the cause of only partially filled rooms when the readers of papers were lacking in sufficient lung power. They say that Demosthenes rehearsed his oratory to the dashing waves on the sea shore; what a grand opportunity for cultivation he missed in not being born a few centuries later, and in Chicago.

The first meeting opened at about 4 o'clock in Columbus Hall, a large amphitheatre in the northern part of the Institute; and when Prof. Elisha Gray, of tautolograph fame, rapped the official gavel, he found before him a large and representative gathering of electrical men from all parts of the world, and when he invited the official delegates to the platform, there appeared such a galaxy of celebrities about him as perhaps has never before been seen in America. Most conspicuous amongst them was the venerable Helmholtz who has done so much for science in Germany. Then there were representing Great Britain Dr. S. P. Thomson, W. H. Preece, Prof. W. E Ayrton and Alexander Siemens, all familiar names in electricity; representing France, Professors E. Mascart and E. Hospitalier; from Germany, Dr. H. Von Helmholtz and Dr. E. Voigt; from Switzerland, Dr. A. Paloz and M. Thury; from Italy, Prof. Galiler Ferraris; from Austria, Dr. Johann Sahulka; and from the United States, Professors H. A. Rowland, Elihu Thomson, H. S. Charhart and Dr. T. C. Mendenhall. Other delegates arrived later during the course of the meetings.

The sight of so much talent here congregated was one long to be remembered. One was sorry, however, not to see the faces of Lord Kelvin, perhaps the king of them all, of the wizard Edison, and of that later advent of genius, Tesla.

After a speech from the chair welcoming the delegates and members of the Congress, organization was proceeded with, and pending the announcements of special committees, there were speeches by Helmholtz, Ayrton, Elihu Thomson, Preece, Mascart (in French), Mendenhall, &c.

Permanent officers were elected, Helmholtz being made Honorary President, and Gray, Chairman. A Vice-President from each country represented was also elected. The Congress then adjourned to meet the next and following days, between the hours of 10 a.m. and 1 p.m., in three sections, that of pure theory, of mixed theory and practice, &c., and of true practice, all sitting simultaneously, rather an unfortunate disposition as afterwards appeared. Perhaps a better arrangement would have been to have a large room for papers of general interest and to have the meetings held, as they were, in the mornings, and to have papers, representing special interests mainly, referred to their own sections to meet in the afternoons or evenings. As it was, nearly all the papers would have been at home in section B. We were a little surprised that in an electrical gathering the management of the time table should have been so unsystematic. The dates for the reading of particular papers were entirely conjectural, so that it kept a member continually on the *qui vive*, dodging from section to section to hear the papers of most interest to him, and perhaps he would retire from an interesting discussion in one section, hasten to another and find that a paper he had desired to hear had been completed, or that he had lost the discussion on another. Of course these papers may be had in print hereafter, but it is likely to be several months before they are obtainable, and in that time they have lost much of their freshness and interest, and the opportunities for discussing them to so great advantage no longer exist.

The work of the sections proceeded from day to day in the rooms allotted to them. The attendance in section A was naturally small, the discussions there being in differentials and vectors. The main part of the Congress alternated between sections B and C, according as the papers in the one or the other were of more general interest. Those that excited the greatest discussion were on "Electromagnetic Signalling Through Space," "Ocean Telephony," "Direct Current Dynamos of Very High Potential," "Long Distance Transmission by Various Systems," "The Conversion of Alternating into Continuous Currents and the Reverse," and "The Arc Light." Owing to the time consumed by some of these papers there were quite a number towards the end of the lists that were only read by title or by a short synopsis, and discussion was greatly abbreviated.

The Congress met finally on Friday afternoon at 3 o'clock in Columbus Hall to hear the report of the delegates. They had held frequent deliberations in private during the week.

The report recommended the adoption of the names that are now in general use of the more elementary electrical units and defines them according to theory and the best practical way of obtaining them according to the results of the best scientific investigators. The higher units remain without names, excepting the designations of the G. C. S. system. Other questions were left in the form of appeals to the scientists of all nations to carry on further investigations and discussions upon them. The principal were concerning notation and nomenclature, and the adoption of a standard of light. The opinion was that no light so far obtained and defined shows sufficient definiteness under known conditions to be taken as a standard.

The Congress then adopted the report and after the announcing of the programme for the further entertainment of the members at the World's Fair, adjourned.

On Friday evening, August 25th, as a treat to the members of the International Electrical Congress, which had been holding its meetings during the week in Chicago, a lecture by Nikola Tesla was given in a room in one of the buildings in the World's Fair grounds. There was a large attendance of members and their lady friends, and the greatest interest was shown by the close attention paid to the experiments and explanations given, and by the hearty applause. The subject matter was on a means of producing mechanical vibrations and the application and the construction of a dynamo with vibrating instead of rotating armature and the nature of the results and their applications.

Mr. Tesla is a pleasant speaker, though not yet free enough with his English to speak very rapidly, and is troubled with neither self-consciousness nor egotistic self-assertion.

His work in this line is still in the experimental stage, but he is very hopeful of good results.

He is so interested in his work and devotes so much time to it that he is in danger of injuring his health. This is greatly to be regretted, as the world should have much to receive yet from the fertile brain of this young inventor.

If you are not a member of the Canadian Electrical Association, send in your application at once, and be elected in time to take part in the Convention at Toronto on the 12th, 13th and 14th.

The Canadian Rubber Company, of Montreal, have commenced the construction of a four story brick and stone warehouse at Winnipeg, at a cost of $12,000.

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ELECTRIC RAILWAY DEPARTMENT.

CHANGES INDUCED BY ELECTRIC CARS.

WITH the introduction of electric railways there have come several important changes in former conditions. Persons whose means would not permit them to keep a horse and carriage are now able to enjoy the luxury of being transported to all parts of the city and suburbs at a trifling cost. These changed conditions have also led many persons to dispose of their horses and carriages and thereby effect a saving of several hundred of dollars per year. On the other hand, the introduction rapid electric transit has proved a severe and almost fatal blow to the hack owners. People who can reach their destination speedily and comfortably in an electric car at a cost of four cents will of course decline to pay a dollar for a hack. The city of Ottawa furnishes an illustration of the effect of the change of conditions upon the hack business. In 1890 the number of licensed hackmen in that city was 198. In 1892 the number had decreased to 127, and this year the shrinkage will be considerably greater still.

RIGHTS OF STREET CARS AT CROSSINGS.

THE Supreme Court of Minnesota has ruled that a street railway car has no priority of way at a street crossing with respect to other vehicles, and when the driver of such another vehicle, approaching the street railway track to cross it, sees a car approaching at such a distance that he can, apparently, make the crossing safely, he has a right to attempt it, and it is not negligence per se in him to attempt it without looking a second time at the car. Upon such travelled tracks in a city it is negligence to run an electric street railway car over a crossing at a high and dangerous rate of speed. And it is also negligence to run it over a crossing, the person in charge of it not being on the lookout, not having the car under control, nor using the proper means to stop it so as to avoid a collision.

ELECTRIC RAIL WELDING.

The operation of welding by electricity the rails of the West End Company in Cambridge, Mass., is attracting a great deal of attention, and interested crowds are constantly on the spot, pushing for vantage ground from which to see the machine at work, and speculating as to how it is done. Many and strange are the theories and explanations advanced by the "knowing ones," the usual quota of whom are always present, says N. Y. *Electrical Review*, and the fragments from this source which occasionally reach the ears of the men employed, contribute greatly to their amusement.

The machine has now been in operation for about a week, and a considerable stretch of track has already been covered, though better progress will be made from now on, as the men are becoming more familiar with the work as it progresses, and are handling it more rapidly in consequence. The system is one devised by the Johnson Company, of Johnstown, Pa., and while they have already done some amount of similar work on their own lines in Pennsylvania, the present contract is the first that has been attempted for outside parties, and the machine now in use is the first one constructed.

The apparatus consists of a box car open at one end to admit of the free operation of the crane which supports the welder, and by means of which it is moved from side to side and placed in position. The opposite end of the car is occupied by a 250 horse-power motor dynamo, manufactured by the Thomson Electric Welding Company, of Boston, by means of which the 500 volt direct current taken from the overhead wires is transformed into an alternating current of about 500 amperes, and passed into the transformer located in the base of the welder, from which it is applied to the rails at 50,000 amperes. The car is also supplied with two 25 horse-power Thomson-Houston railway motors for operating it on the tracks, and contains water tanks with a capacity of 500 gallons. This water is kept in constant circulation by means of a small pump, and passes through rubber pipes to the copper contact pieces of the welder, keeping them always cool. The welder itself is a massive affair weighing four tons, and is suspended from the crane immediately over the joint to which it is to be applied. It is fitted with two immense jaws which grip the rail on either side after the steel spanners have been put in position. These jaws are operated by a toggle joint worked by a right and left handscrew. By this means one man is able to apply a pressure of 40,000 pounds.

When the joint is held in this vise-like grip the current is turned on, and in a few seconds the rails at the point of contact begin to glow and are soon at a white heat. By this time the joint is closed up and the steel pieces on either side, under the immense pressure, have become a part of the rail itself. The current is then turned off, the grip loosened, and the car moved forward to the next joint.

The crane supporting the welder was built by Yale & Towne Manufacturing Company, of Stamford, Conn., and is operated by a small one horse-power Crocker-Wheeler motor perched on top of it directly under the projecting roof of the car. The contrast between the size of the motor and the bulk it operates is very striking. The total outfit as at present constructed weighs 30 tons, but another car is now being built which will be lighter to handle, and by which the work can be done more rapidly. The Johnson Company have a contract to weld 16 miles of track for the West End as a practical test of the system, and if the results are satisfactory the work will be continued over the entire line.

W. M. Brown, of the Johnson Company, who is in charge of the work, estimates that it will take them three months to carry out the present contract.

ELECTRIC RAILWAY—ACCIDENT—NEGLIGENCE.

THE Supreme Court of Georgia held, in the recent case of the Augusta Railway Company vs. Glover, that although there may be no negligence whatever in the failure of an electric street railway company to have gates to the platforms of its cars, for the purpose of guarding against accidents to passengers by preventing them from leaving the cars on the side next to a parallel track of the same company in the street, yet when a particular company has such gates to the platforms of its cars, not to keep them closed may or may not be negligence in the given instance, the question being one of fact for the jury, and that an electric railway which has provided its cars with gates to prevent passengers from alighting on the side next to a parallel track could not defend itself against the charge of negligence in not keeping one of the gates closed, by the evidence of its president "as to observations he had made in reference to electric street-car lines, cable-car lines and other street-car lines operating on double tracks, that he had made recently in various cities of the United States in reference to the use of gates on the cars, and to show that gates are not used."

John Stephenson, who built the first street car in America, and who subsequently became the head of the most extensive manufactory in this line in the United States, died in New York last month, aged 84 years.

In the action of Rev. R. Hobbs against the Niagara Falls Tramway Company, in which the plaintiff sought to restrain the company from operating their line on Sunday, the High Court of Justice has decided in favor of the defendants.

THE BLACKENING OF LAMP BULBS.

Few subjects have given rise to more speculation than the blackening of the bulbs of incandescent lamps. At one time it was said to be due to platinum thrown off from the leading-in wires. Then it was due to something mysteriously called "air washing." Some people are fond of working mystery into explanations of anything where electricity or high vacua are concerned, so that when they exist together there is a double tendency towards the mysterious. Recently mercury vapor has been said to be the cause of the blackening, but this theory seems to have been developed more especially by American inventors of mechanical pumps which do not use mercury. There is still another theory, due, we believe, to Sawyer, according to which there is some oxygen in the bulb, which combines with the carbon at the very high temperature produced, then deposits the carbon on the glass and goes off to the filament again for more, and so on. It does not matter at all with this theory that there is no known oxide of carbon which decomposes automatically at a low temperature. In a vacuum and in an electric lamp the laws of chemistry ought, it would seem, to be quite different from the humdrum laws of Nature under pressure with no electric current about. It is possible that hot carbon slowly volatilizes considerably below its melting point, just as camphor does. This theory would be too simple, however. It would be safer to assume that the difference of potential between the legs the filament causes currents across the air space—hot rarefied gases being good conductors—and that these cause the carbon to leave the filaments and to be deposited on the glass. The whole subject requires to be investigated carefully, and would probably well repay any time and trouble expended upon its elucidation.—*London Industries.*

PUBLICATIONS.

We welcome the first number of the *Engineering Review* published in London, Eng., and edited by Mr. J. Stephen Jeans, late Secretary of the Iron and Steel Institute of Great Britain. The new journal aims to fill a position in the engineering field similar to that occupied in the field of liberature by the *Review of Reviews*. Mr. Jeans is apparently well qualified to make a success of the venture, and we trust that he may succeed in doing so.

SPARKS.

Mr. R. L. Borden has been appointed by the Supreme Court, trustee of the Halifax Illuminating and Motor Company.

An overhead bridge 40 feet wide, is to be constructed at Mile End, by the Montreal Park and Island Railway Company.

The Welland Power and Supply Canal Company, of St. Catharines, Ont., are applying for incorporation with a capital stock of $500,000.

The electric light plant which served to light the streets and business premises of St. Mary's, Ont., was partially destroyed by fire on the 8th of August.

The City Attorney of Montreal gives it as his opinion that the Montreal Street Railway Company have no exclusive running privileges over the streets of that city.

A resolution was recently passed by the Board of Trade, Ottawa, recommending that a bill for the inspection and measurement of electricity be brought before Parliament.

The Chambers Electric Light and Power Company of Truro, N. S., have offered to erect and operate 40 arc lamps and a fire alarm service in that City for the sum of $3,000 per year.

The Montreal Street Railway Company has been granted a 30 years franchise by the council of Coteau St. Louis. The Company expect to have cars running to Amherst Park within a month.

The C. P. R. are about to construct a new telegraph line 300 miles in extent, to connect Halifax with Sydney, C. B. It is proposed to lay one cable across the Strait of Canso and one at the Grand Narrows.

A Detroit syndicate is endeavouring to secure a charter for an electric railway from Walkerville to Tecumseh, a distance of 13 miles. The company offer to give a bond as a guarantee of the early completion of the undertaking.

The Automatic Telephone and Electric Company of Canada are said to contemplate a no less extensive undertaking than that of constructing a metallic telephone circuit from Halifax to Vancouver, a distance of 3,500 miles.

Mr. R. Lynch has retired from the firm of Nie & Lynch, engine and boiler manufacturers, Hamilton, Ont. The business will be carried on under the management of the remaining partners under the name of Nie & Witfield.

The Town Council of Edmonton, N. W. T., recently resolved to seek legislation for the establishment of an electric railway system in Edmonton and the vicinity and to provide for its operation either by the municipality or by a company.

The receipts of the Montreal Street Railway Company for July last exceeded those of the previous year by $9,000. The number of miles travelled by the cars in July, 1893, was 282,696, as compared with 93,601 in 1892. The Royal Electric Company are to furnish the Street Railway Company with 500 additional horse power.

Mr. Bert C. Lee, of Pittsburgh, Pa., has been appointed electrical engineer of the Ottawa Street Railway Company. Mr. Lee is a native of China, but has resided for some twenty years in America, and has travelled extensively in Europe and the United States in the interests of the Westinghouse Company, of Pittsburgh. He is said to be a most competent engineer and electrician.

MOONLIGHTS SCHEDULE FOR SEPTEMBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1	P. M. 7.00	P. M. 10.20	3.20
2	" 7.00	" 11 00	4.00
3	" 7.00	" 11.50	4.50
4	" 7 00	A. M. 12.50	5.50
5	" 6.50	" 1.00	6.10
6	" 6.50	" 2.00	7.10
7	" 6.50	" 3.20	8.30
8	" 6.50	" 4.30	9.40
9	" 6.50	" 4.40	9.50
10	" 6.50	" 4.40	9.50
11	" 6.50	" 4.40	9.50
12	" 6.40	" 4.40	10 00
13	" 6.40	" 4.40	10.00
14	" 7.10	" 4.40	9.30
15	" 7.40	" 4.40	9.00
16	" 8.20	" 4.40	8.20
17	" 9.00	" 4.40	7.40
18	" 10.00	" 4.40	6.40
19	" 10.50	" 4.40	5.50
20	" 11.50	....	4.50
21	....	" 4.40	
22	A. M. 1.00	" 4.40	3.40
23	" 2.20	" 4.50	2.40
24	" 3.20	" 4.50	1.30
25	No light.	No light.	....
26	No light.	No light.	....
27	No light.	No light.	....
28	P. M. 6.20	P. M. 8.20	2.00
29	" 6.20	" 9.00	2.40
30	" 6.10	" 9.40	3.30
		Total,	166.50

The Third Convention of the Canadian Electrical Association at Toronto, on the 12th, 13th and 14th, promises to be the best that has yet been held. Will you participate in the pleasure and profit of the occasion?

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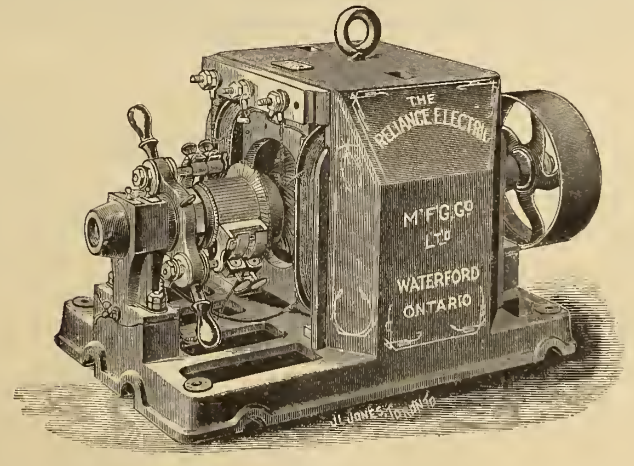

WRITE FOR PARTICULARS AND PRICES.

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749 Craig Street.

CARBONS

Some Particulars of the Process of Manufacture.

CARBON is an elementary substance, occurring in nature uncombined, as the diamond and mineral plumbago. It is much more abundant, however, in a state of combination ; thus it occurs in union with oxygen in the carbonic acid present in the atmosphere, and in combination with oxygen and calcium, forms in the shape of limestone a large portion of the earth's crust. In union mainly with hydrogen, it is the chief constituent of coal and mineral oils, and along with oxygen, hydrogen and nitrogen, is an abundant ingredient of animals and still more so of plants. It exists in several altropic forms, that is, forms which differ from each other in many physical and some chemical properties, but which nevertheless consist of nothing but single element.

Wood carbon, or charcoal, is prepared by heating wood in iron retorts as long as it evolves anything volatile. When coal is treated in the same manner as it is in the manufacture of coal gas, the excess of carbon is in like manner left behind, forming a hard shining light solid, valued as an economical and powerful fuel. This substance, which is literally charred-coal, and therefore best deserves the title of charcoal, goes nevertheless by the name of coke. A variety of this material is found in the upper parts of the gas retorts, and is probably formed by the decomposition of gaseous compounds of carbon and hydrogen. It is very hard and porous with almost a metallic lustre, and is a good conductor of heat and electricity, but this is of little value, if any, in the carbon business. However, 25 per cent. of this coke mixed with 75 per cent. of petroleum coke, is said to make a good carbon for low tension work. Another variety of this material is obtained from the oil regions, commonly known as petroleum coke. This is a by-product of the oil stills, and is the only kind used to any great extent in the manufacture of carbon points for the electrical industry. It is of primary importance that the coke, and in fact all the ingredients used, be absolutely free from impurities. Sulphur, iron and dirt—such as shale, sand and other foreign matter which by careless handling may get in—are the impurities frequently met with, but sulphur is by far the worst the carbon maker has to contend with ; but by using the very best of coke which is obtained from Pennsylvania oils, trouble from this source is reduced to a minimum. The other constituent of our carbon is pitch. This is made from coal tar which is a by-product of the gas retorts. It may also be obtained from blast furnaces, but this kind is more or less contaminated with iron, and therefore is unfit for this class of work. Pitch for this particular purpose is difficult to obtain, as the makers do not care to expose their still to the high temperature necessary to drive out all of the oil, and reduce it to he proper specific gravity.

The first step in the process of manufacture is that of crushing the coke. This is accomplished by means of a machine somewhat n appearance like a mammoth coffee mill. The coke comes from this crushed to about the size of coarse gravel ; it is then automatically elevated to a large bin in the upper part of the factory, and from there it is conveyed to a large iron hopper situated directly over the calcining retorts. Into these the granulated coke is conducted by means of spouts with gates arranged to control the flow of material into the several aforementioned retorts. They are then sealed up, thereby preventing combustion, with the exception of a few vents to allow of the escape of gas, arising from the heating of the coke to a state of incandescence, which point is reached in from twenty-four to forty-eight hours after firing. After this if the coke is not pure it will be found to have caked, necessitating in some cases the use of bars to break it up sufficiently to allow of it being drawn from the retorts. If pure it will appear crisp and dry and to have suffered a loss in weight of about 30 per cent. After retorts have been drawn sufficiently long to allow of cooling, their contents are elevated to the milling department and run through a set of French burr stones incased in iron, very similar to the grist mill chop stones; then through a silk bolter separating the coarse from the fine, the former returning to the milling machine, the latter being conveyed to bins with suitably arranged spouts over scales from which it may be drawn and weighed as required by mixing department. The other ingredient, namely, pitch, is a dense, hard solid, very brittle and dry, and in appearance somewhat resembling gutta - percha. This material, when it reaches the factory, is incased in casks, holding about 600 lbs. each. It is then broken up by the men into a convenient size for handling, and subjected to a granulating process similar to that of the coke ; finally we find it at a close spout beside the one from which the coke can be drawn. Upon the manipulation of the materials at this stage the success of the future carbon greatly depends, in fact the great secret lies in the mixing. We can better understand the skill and care required to properly amalgamate the mixture when we learn that each particle or grain of coke must have its individual coating of pitch, and it may be interesting to learn that this coke is ground so fine that a grain magnified a thousand times would only appear the size of a shot. To obtain these results the materials are carefully proportioned by weight and placed in a mixing barrel. This is a rotating cast iron cylinder within which revolves, in the same direction and twice as fast as the cylinder, an independent shaft, to which are attached arms so arranged that every part of the barrel is covered or swept in each revolution. This is attached to a furnace in such a way that the flues follow the whole circumference of this barrel, maintaining a uniform temperature of 300° F. which is necessary to bring the pitch to a state sufficiently plastic for amalgamation ; thirty minutes is the time required for each batch, which would make about 1,600 carbons. From this machine it is taken to the cooling room and spread out for ten or twelve hours to cool. Here the mixture solidifies to such an extent that it becomes necessary to pulverize it again, to perfect it for the moulds. This end is attained by means of a mill, the pulverizing feature of which is two discs thirty inches in diameter, with corrugated face plates revolving in opposite directions at the rate of fifteen hundred revolutions per minute (about one one-hundredth of an inch apart). From this it is once more passed through a bolting machine, and then finding its way down gravity tubes to a bin on the floor below (which is the moulding room) it is carefully weighed out by the workmen on peculiar little scales with clock like dials, in quantities just sufficient to fill each mould as it comes hot from the oven. It having been previously lubricated with some heavy oil, is now ready for its charge, which the operator places in it and works evenly over the whole surface with a spatula, to insure uniformity of density. The cover or top half is placed in position and the mould and its contents passes for a few moments into an oven, the temperature of which is about 300° F. As soon as the mixture has become quite adhesive the mould is placed in the hydraulic press, and subjected to a pressure of several hundred tons. The mould is now removed and opened, and we have a corrugated card containing sixteen or eighteen carbons, each one being joined to its neighbor by a fin which is inevitably formed when subjected to the enormous pressure before mentioned. These cards are placed on plates which are fitted to receive them perfectly. These plates with their contents are piled up and weights placed thereon to prevent warping. When cool they are broken apart, gauged for size, culled, and the fin scraped off. They are then laid in the furnace for baking. This furnace is rectangular in shape, 34x11, four feet deep and made of fire brick, and is similar to a large vat set about two-thirds below the surface of the earth. Over this when filled is placed a dome shaped cover, sufficiently high above the sand and tile which covers the carbon to allow of a free passage of the flames, and which is continued by flues hack through the sides and also underneath, thus completely enveloping the body of the furnace. The carbons are carefully placed in the furnace and separated from each other with washed sand. Some days are required to completely load a furnace, as each section will hold about seventy-five thousand carbons. The cover having been placed in position and sealed with fire clay, the fire is now started, crude oil being the fuel used, as well as in the case of the retorts and moulders' oven. If the resistance of the samples shows that the contents of the furnace have been sufficiently baked, it is unloaded, the hot carbons being handled with forks. When cold they are sorted, the first and seconds being easily determined by rolling on level steel plates. After this inspection they are ready for the plating room, where they receive their copper coat by being hung in leaden vats containing a saturated solution of sulphate of copper. These vats, of which there are several dozen, are connected in series with a twenty ampere constant current dynamo. Twenty minutes to half an hour is the time required to complete this plating process. They are then washed in hot and cold water and placed on racks to dry, after which they go to the packing department to be rolled in paper and boxed for shipment.

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CARBON POINTS OF ALL SYSTEMS OF ARC LIGHTS,

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and all kinds of Porcelain for Electrical and Hardware Lines.

This company are now making a carbon equal to any made in the States, and guarantee satisfaction in every respect. The following letters, comprising the largest consumers in Canada, will fully substantiate the above statement, and we kindly solicit the whole Canadian trade, offering the assurance that we will use every effort to please our patrons :—

OTTAWA, April 24th, 1893.

THE PETERBORO' CARBON AND PORCELAIN CO., Peterboro', Ont.

Gentlemen : In reply to your request we now have the pleasure of certifying to the good quality of the carbons you have been supplying this Company. We have heretofore been buying from the Carbon Companies of Cleveland and elsewhere, but the last lot of 200,000 which we received from you, we found gave us better satisfaction, both as to life and light, than any we have ever had. We think it would be but a short time when the Canadian carbon market would be all your own.

Yours truly,

THE OTTAWA ELECTRIC LIGHT CO.

(Signed) A. M. SPITTAL, Sec'y-Treas.

J. W. TAYLOR, ESQ., TORONTO, March 16th, 1893.

Sec. Peterboro' Carbon and Porcelain Co.

Dear Sir : We would like you to increase monthly shipments of carbons, as our stock is getting too low. The carbons are now giving us excellent satisfaction. We shall be glad if you can make a monthly shipment of 150,000 for three months, which will increase our stock sufficiently, and thereafter ship 100,000 per month until further orders. Do not fail to send at least 150,000 or 175,000 this month.

Yours, &c.,

THE TORONTO ELECTRIC LIGHT CO. (LIM.)

J. J. WRIGHT, Manager.

J. W. TAYLOR, ESQ., MONTREAL, February 22nd, 1893.

Sec.-Treas. The Peterboro' Carbon and Porcelain Co., Peterboro', Ont.

Dear Sir : In reply to yours of the 20th instant, I beg to say that the carbons which we are using at the present time for our city and commercial lights are giving us entire satisfaction, and I have made comparative tests with the Brush (first quality), and I find there is little or no difference, and as long as you continue to manufacture the same quality of carbon which you are at the present time, there is no reason why it should not displace or supersede all other Carbons in Canada.

Yours truly,

THE ROYAL ELECTRIC CO.

J. F. BADGER, Jr., Supt. Light and Power Dept.

J. W. TAYLOR, ESQ., HAMILTON, April 20th, 1893.

Manager The Peterboro' Carbon and Porcelain Co., Peterboro', Ont.

Dear Sir : It gives us much pleasure to say that we are using carbons of your production in our lamps and find these we now have compare very favorably with the best makes from the other side. We will thank you to book our order for 25,000 7-16 c. c. to be delivered about the middle of next month. We should like to have a few samples of your one-half in. x one inch oval carbons, plain, when you get them out; we think they will turn out to be an A No. 1 carbon for all night use.

Yours very truly,

HAMILTON ELECTRIC LIGHT AND POWER CO.

D. THOMSON, General-Manager.

ST. JOHN, N. B., February 15th, 1893.

THE PETERBORO' CARBON AND PORCELAIN CO., Peterboro', Ont.

Gentlemen : A few days since we referred the Halifax Illuminating and Motor Co. to you for some carbons that they were in need of, and it may be that you can get some business from them. We have also to-day sent a box of your carbons to the Fredericton Electric Light Co., and if you will send them quotations upon carbons you may also do something with them. We have in both cases recommended your carbons as being a very good article.

Yours truly, THE CONSOLIDATED ELECTRIC CO., Ltd.

C. D. JONES, General Manager.

SPARKS.

The new electric street railway at Peterboro' is now in successful operation.

The new electric street railway at Kingston is almost ready to be put in operation.

There is on foot at Chatham a movement to organize a local incandescent electric light company.

The subject of a suitable fender for trolley cars is engaging the attention of the Hamilton city council.

It is said to be the intention of the Hamilton Street Railway Company to extend their line next year to Hamilton Beach.

The Bell Telephone Company will spend the sum of $3,000 in replacing crooked poles and painting their poles in London.

Mr. A. W. Congdon has been appointed to succeed Mr. C. F. Medbury as agent for the General Electric Company at Montreal.

The Lake Girard mica mines works at Ottawa have been closed down for two months for the purpose of placing in position new machinery.

The Nanaimo Electric Light Company will hereafter render accounts to customers monthly, and promptly cut off the supply in the case of users in arrears.

The Sandwich, Windsor and Amherstburgh Electric Railroad Company are seeking from the Council the privilege of extending their road to the Canadian Pacific Railway.

The C. P. R. have commenced the construction of a telegraph line along the Soo Railway, thus giving the company an alternative line between the south-east and the west.

The telephone line between Kalso and Nelson, B. C., has been purchased by the C. P. R., who will operate it in connection with their telegraph line to New Denver now under construction.

The Toronto Street Railway Company is looking for a suitable site on which to erect a foundry, the intention being to manufacture everything required in the way of appliances for the road.

The City Council of Fredericton, N. B., has accepted the tender of the Brush-Swan Company to light the city with 50 arc lights of 12,000 c. p., at a cost of $2,000. The plant will be installed at once.

The Montreal Street Railway Company has been given an exclusive thirty years' franchise, for the construction and operation of an electric street railway in the town of Cote St. Antoine, and also exemption from taxes for the same period.

The court has dismissed the motion brought at the instance of Mr. John Kay to quash the by-law of the Township of Etobicoke granting a bonus of $10,000 to the Toronto and Mimico Electric Railway. The bonus will accordingly accrue to the railway and insure the completion of the enterprise.

The employees of T. W. Ness & Co. and a large number of their friends held their first annual picnic at St. Rose, on Aug. 24th, which was largely attended. An attractive programme had been arranged by the committee, which included races and athletic sports as well as a baseball match between the Electrics and Clippers, which resulted in the defeat of the latter by a score of 11 to 9. The picnic was a most successful one, and was thoroughly enjoyed by all present.

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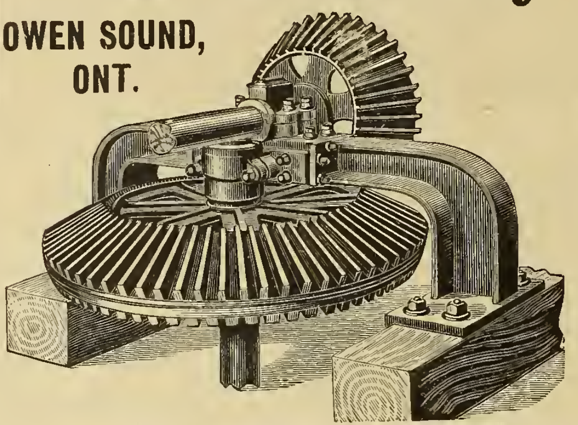

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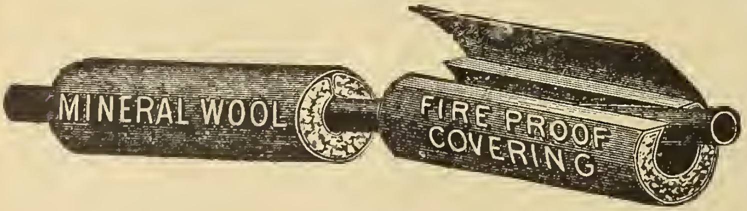

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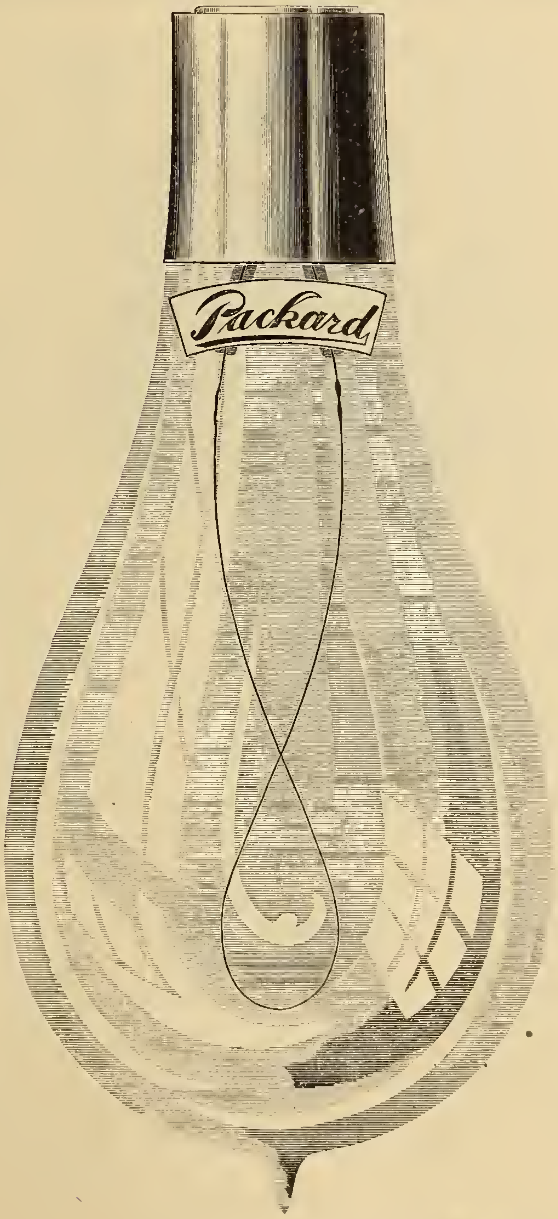

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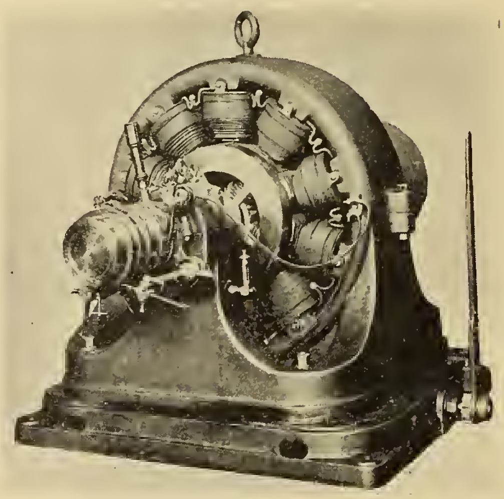

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SPARKS.

The Pontiac Telephone Company propose to extend their system to Pembroke, and will put in 60 telephones between Guyon and Fort Coulonge.

Incandescent lighting plants will be installed at Simcoe, Ont., by the present local lighting company and also by the Reliance Electric Mfg. Company, of Waterford.

Col. James N. Clark, of Windsor, Ont., was in London recently looking over the possibilities for obtaining an electric street railway franchise, and submitted an offer which the Council is considering.

The eastern members of the Electrical Congress held at Chicago, enjoyed a ride over the Niagara Falls Park and River Railway on the 20th of August, by invitation of Mr. A. W. Grant, the manager.

The employees of the Royal Electric Company, of Montreal, held their fourth annual picnic at Otterburn Park a few days ago. A lengthy programme of sports was carried out, Messrs. Hager, Henshaw, Hunt and Starr acting as judges. The day was one of much enjoyment.

The city of Windsor has granted the Sandwich, Windsor and Amherstburg Electric Railway Co. a 20 years' franchise, the company agreeing to pay $500 per year for the first ten years and $1,000 per year for the balance of the term. Mr. W. J. Pulling is the Secretary of the company.

The Chaudiere Electric Light Company, of Ottawa, have decided to proceed at once with the erection of their new power station. After receiving tenders for the necessary plant, the company decided to put the machinery in themselves. The station will be equipped with a 1,200 h. p. plant, and provision made for future extensions. The building and plant will cost about $20,000. As a safeguard against flying sparks setting fire to the lumber piles in the neighborhood, it is proposed to erect a chimney 120 feet high.

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It is proposed to extend the Brantford Street Railway to Echo Place, and possibly to Bow Park.

A person giving the name of Geo. F. West, and hailing from Toronto, was recently summoned before the court at Milton, Ont., for selling "Bottled Electricity" for the cure of a variety of diseases. West was discharged with a caution.

The water required for the steam plant of the Consolidated Electric Co., of St. John, N. B., has to be brought from the harbor, a distance of 500 feet. The great rise and fall of the tide makes this a somewhat difficult matter. A pumping station was built on the end of the wharf at the foot of Union street. In this was placed a geared duplex power pump manufactured by the Northey Manufacturing Company, of Toronto, weighing about six tons and with a capacity of 1,500 gallons a minute. The large pump has to raise the water by suction and then force it to the station. At low water the lift is great while at high tide it is light. The pump is operated by a 30-h. p. dynamo stationed with the power station machinery. The condenser is what is known as a surface condenser, and is similar in design to those used on ocean steamers, but much larger.

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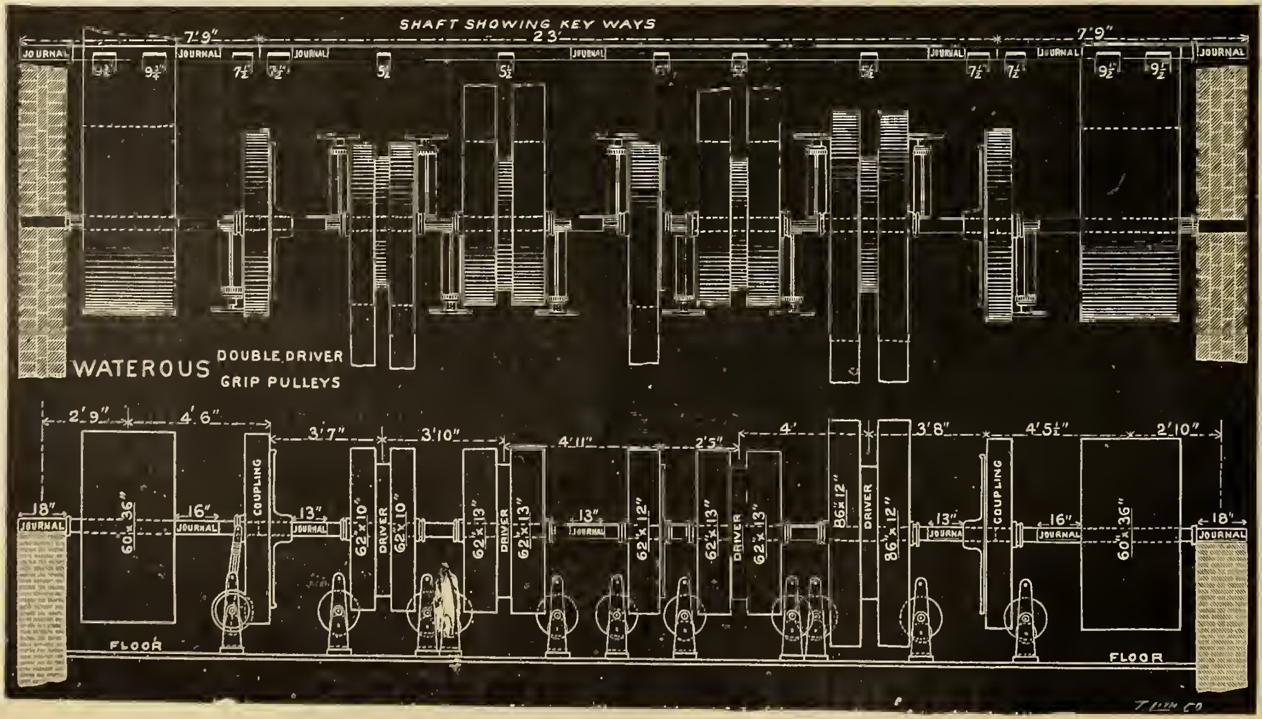

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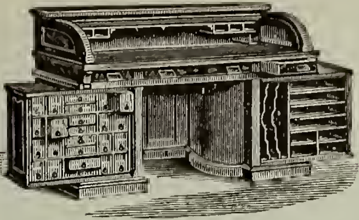

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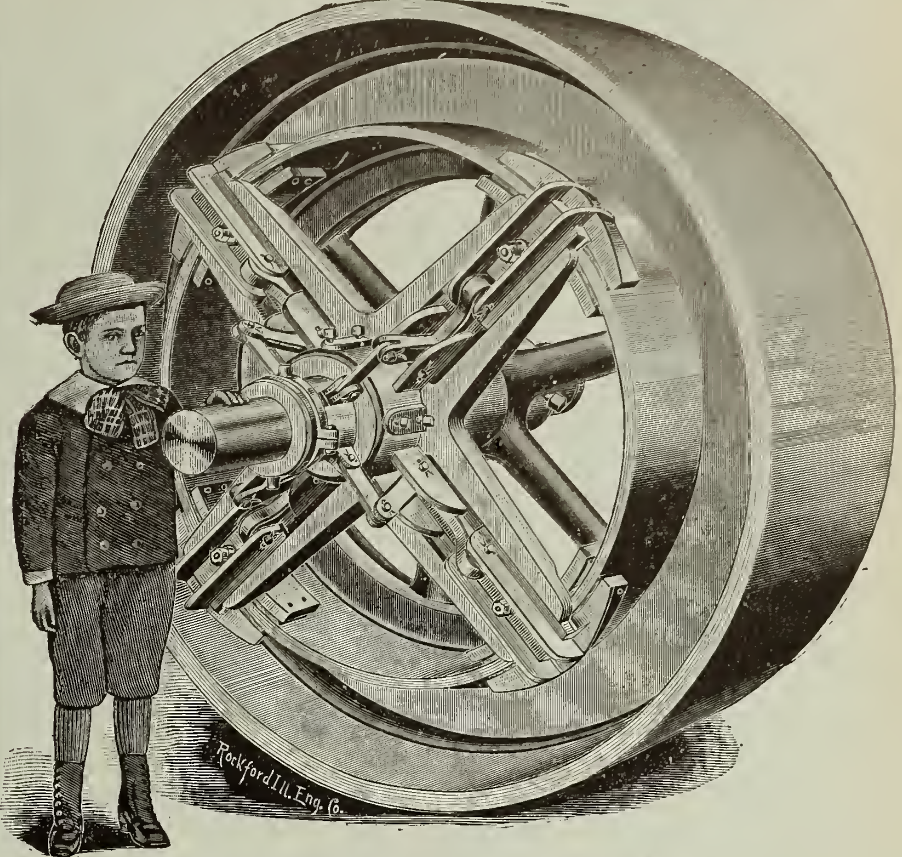
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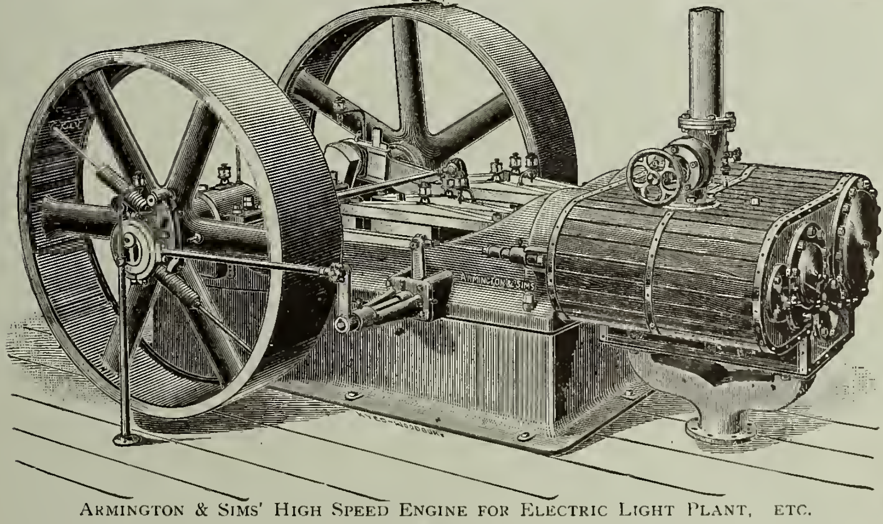

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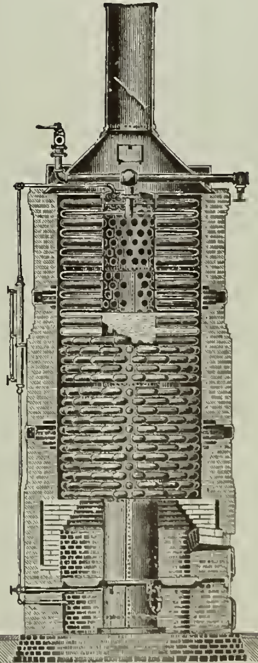

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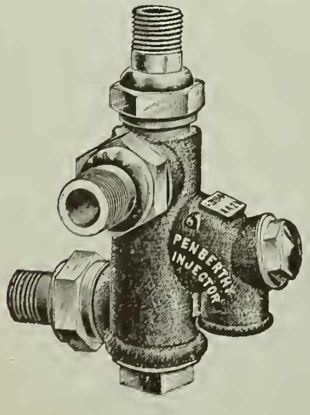

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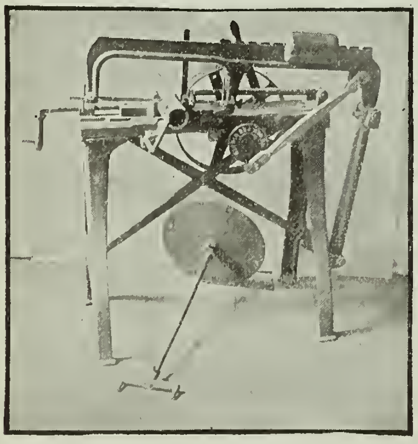

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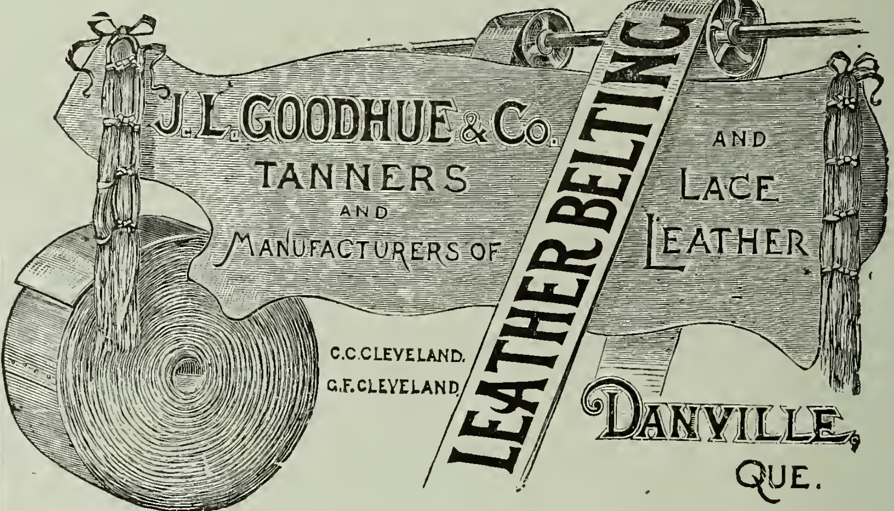

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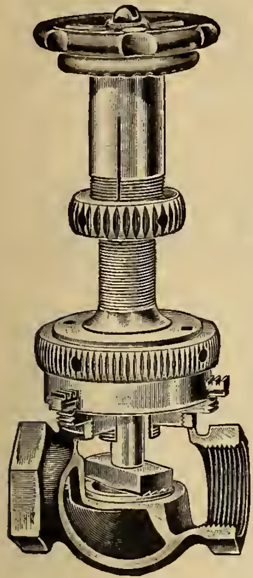

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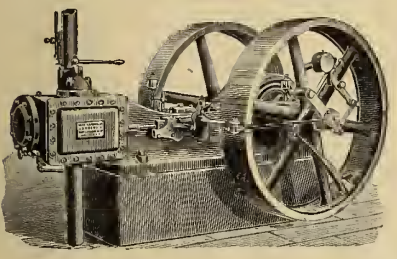

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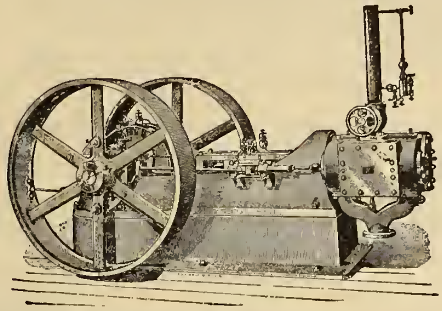

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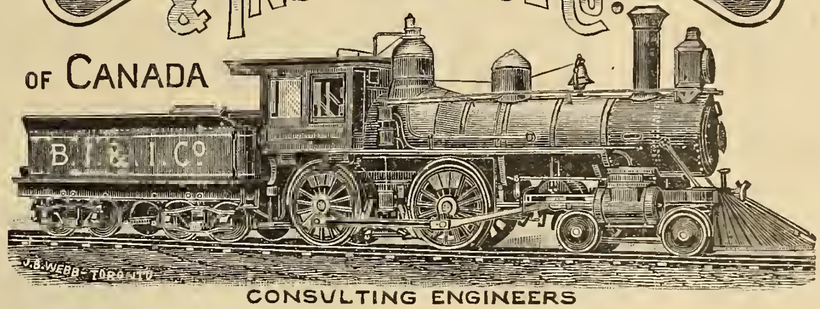

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NOTE THE FOLLOWING:

THE CONSUMERS OIL REFINING CO.,
PETROLEA, ONT., August 22, 1893.

MR. S. FUGE, LONDON, ONT.

DEAR SIR,—Replying to your letter of the 18th inst., we would say that the drum of "Anti Scale" which we purchased from you gave us good satisfaction. We have found it very efficient in removing the scale and keeping the boiler clean without injury to the steel.

Yours truly,
THE CONSUMERS OIL REFINING CO.
(Signed) T. WOLFE, Manager.

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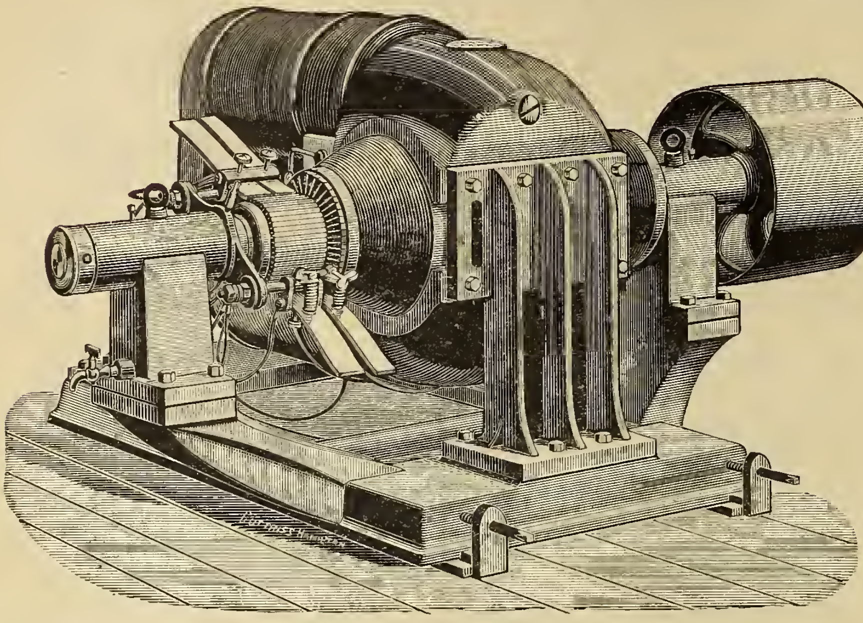
No. 263 James Street N., Hamilton, Ont.



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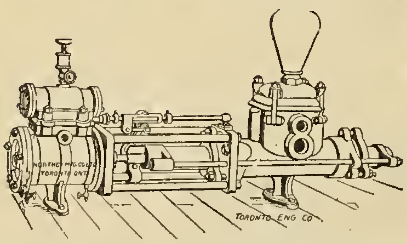

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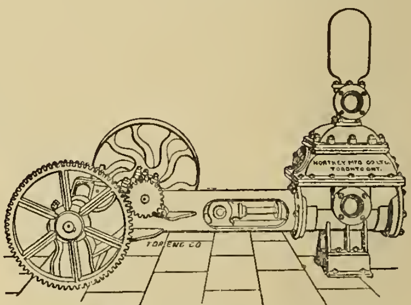

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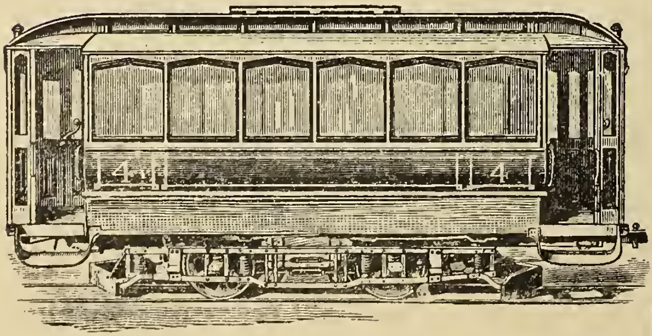

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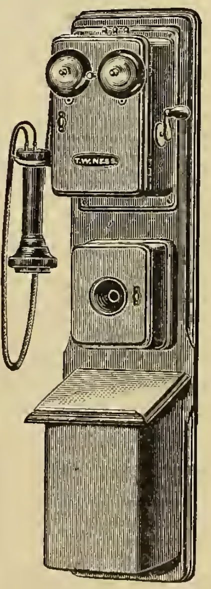

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Local exchanges fitted up. All line material supplied.

STE. JULIE, Sept. 5th, 1892.

T. W. NESS, ESQ., Montreal.

DEAR SIR,—We are happy to state that your telephones and switches are giving us good satisfaction. We have three sorts of switches and we find yours far preferable. There are now about forty of your telephones in operation on our line. Every one works well, and we intend to use no other.

Yours very truly,
THE MEGANTIC TELEPHONE CO.

Write us when you want anything electrical.

Key Sockets,
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CANADIAN

ELECTRICAL NEWS

AND

STEAM ENGINEERING JOURNAL.

Vol. III. OCTOBER, 1893 No. 10.

CANADIAN ELECTRICAL ASSOCIATION

PROCEEDINGS OF THE THIRD CONVENTION.

THE third convention of the Canadian Electrical Association opened at 2 o'clock p m. on Tuesday, Sept. 12th, in the Directors' Hall on the Industrial Exhibition Association's grounds, Toronto. An hour previous the Executive Committee met and elected a dozen new members. Mr. J. J. Wright, President of the Association, presided at the executive meeting, and also at the subsequent meetings of the Association. At the latter there were present the following members :

J. J. Wright, K. J. Dunstan, C. H. Mortimer, John Galt, C.E , A. B. Smith, W. A. Tower, Frederic Nicholls, J. H. Armstrong, W. A. Martin, E. B. Merrill, T. R. Rosebrugh, F. C. Robertson, W. A. Johnson, J. H. Kammerer, Hugh Neilson, F. C. Stannard, H. P. Dwight, A. M. Wickens, Norman Smith, C. E. McManus, John Langton, W. J. Jones, Chas. Dwight, W. T. Rutherford, H. F. Dennis, Jas. A. Baylis, F. J. B. Seaver, Toronto ; L. B. McFarlane, F. Thomson, John Carroll, D. A. Starr, Montreal ; B. J. Throop, R. G. Black, Geo. Black, D. Thomson, W. F. McLaren, Hamilton ; H. O. Fisk, A. C. McCallum, J. S. Knapman, Peterboro' ; A. A. Wright, C. H. Wright, Renfrew ; John Yule, Guelph ; J. H. Thompson, Ottawa ; E. Carl Breithaupt, Berlin ; Alex. Taylor, Edmonton, N. W. T.; R. G. Moles, Arnprior ; W. G. Fraser, Petrolea ; Alfred C. Lavelle, Kingston ; W. B. Evans, Napanee ; H. W. Kent, Vancouver, B. C.

The convention having been called to order, the President delivered his address as follows :

PRESIDENT'S ADDRESS.

GENTLEMEN OF THE ELECTRICAL ASSOCIATION : It has again become my pleasing duty to meet you in Convention assembled, and at this our annual session to congratulate you on the progress we have made as an Association and on the success which has attended our efforts to advance the interests of the electrical fraternity.

It is not necessary for me to elaborate any platitudes on the wonderful progress being made in the utilization of electricity. This is evident enough to impress even the most thoughtless. The multiplicity of electric cars on our streets, the telephones in our houses and the electric motors in our workshops, are eloquent realities that impress the fact upon our notice. Apart from the rapid increase of what may be termed the standard uses of electricity, the most notable development appears to be in the increasing use of alternating currents, especially of higher tension than has heretofore been considered practical or advisable. The use of these currents for purposes of light and power will increase with the advent of a practicable motor, and it is possible in the near future that current for arc and incandescent lighting and motive power will be distributed from one source of supply. The chief obstacle to a complete and comprehensive distributing system is the difficulty in running these generators into the mains in multiple arc, though even in that line what is now experimental may become in the near future a practical method of operation. We are looking for further developments on this line as it appears to be at present the most promising field for the enterprising inventor. After the consideration of the various papers that will be presented for discussion the most important duty of this convention will be the election of officers to administer the affairs of the Association for the coming year. I would like to remind you of the importance of this duty. The continued success of the Association depends on a judicious choice. On your part you should endeavor to select progressive, vigilant men, prompt to grasp an opportunity as it presents itself and with ability to use it to the best advantage. On the part of members who may be chosen to take part in the administration of affairs, I would urge upon them to accept the honor attached to an executive function and to do their best to attain success along the lines laid down, but on no account to accept an office unless prepared to give proper time and attention to its necessary duties I also wish to impress upon the members of this Association, if they would become a power for usefulness, the necessity of taking hold of questions as they arise and dealing with them on new and original lines. It is the duty of an organization of this calibre to lead, not to follow. I am still hoping that you will take in hand and endorse with your authority a standard of illuminating power for arc lamps, one that shall be recognized, in this country at least, as authoritative and final, and shall be referred to as the Canadian Electrical Association Standard. If this had been done at the Hamilton convention when first proposed, we should have led the world. The opportunity still exists, however, as the Chicago Congress failed to take definite action. It still exists, though not to the exclusive extent that it might have done. It will not do to be satisfied to fall in at the tail of the procession and take a back seat as we did, simply because the cross roads village of Podunk has had a four ampere system palmed off on it for 2000 candle power. If we are to adopt nothing but American ideas, or Chinese ideas, or antediluvian ideas, we may as well cease to exist and let other people do our thinking for us.

It will not be out of place, I think, to refer to the most recent scheme that has the use of electricity as an important factor in its development. I refer to the "*multum in extenso*," the Hurontario ship canal. I mention this because of the unbounded opportunities it is to open up for electrical operations. The power to be developed, I think it is a million horse power, would appear to offer unlimited possibilities. Of course if the flow of water down the canal to produce all this power made such a current that vessels could not sail up it, that would be a minor consideration. Perhaps a portion of the power could be turned into electric locomotives and made to tow the vessels up against the stream. It might not be quite salubrious to drink the water after it had been well greased by the refuse from the many vessels that are expected to use the canal, but that also would be a minor consideration. We might again suggest the use of electricity in the form of a slight addendum of Jersey lightning if it was found that too many microbes were disporting themselves to the square centimetre. It is unfortunate that more details are not forthcoming as to the method of combining the various uses of the canal, so that we should not be compelled to speculate how it is all to be done. The necessity of much electrical transmission might be avoided by building the canal as nearly level as might be, so that all the fall would be at this end where the power is wanted. True there would be the trifling drawback that the lower twenty miles or so of the canal would have to be built on trestles, but as probably nothing is impossible to the mind of the enterprising projector, we confidently wait the development of the scheme.

You will have before you a Report of the Committee on Statistics. It is to be regretted that the returns are not more complete, but sufficient has been gathered to be of considerable interest. It is probable that when the different concerns realize that this information will be a benefit rather than an injury to their interests, the returns may be made more full and comprehensive.

Before proceeding with the business of the convention, I wish to express to you my deep sense of the honor conferred upon me by my election as President of this Association during the last two terms. If I could express in words how much my ability to serve you has fallen short of my will, I would do so, but you may rest assured that the two years of my incumbency will remain as a pleasant recollection to the end. I hope that my successor in office will find his paths as pleasant and his burden equally light.

SECRETARY TREASURER'S REPORT.

During the half year which has elapsed since the last convention of the Association held in this city, the attention of the executive officers has been largely engaged in making the necessary preparations for the present meeting. At an executive meeting held on the 17th of May, the place and time of convention was considered, and it was decided that if arrangements could be made with the Exhibition authorities, it would be advisable that it should be held during the second week of the Industrial Exhibition, and on the exhibition grounds. The courtesy of the Exhibition management has made it possible to carry out the proposed arrangement.

As the result of a discussion of the subject of an electrical exhibition to be held simultaneously with the sessions of the convention, it was deemed wise that the Association should not assume any responsibility in connection therewith, but that manufacturers should be invited to exhibit on their own account. The display which the manufacturers have made in response to this invitation is most gratifying to the Association and creditable to the exhibitors.

An invitation was extended by the Executive to Mr. Nikola Tesla to deliver on the occasion of this convention a popular lecture on Electricity. It is much regretted that Mr. Tesla felt unable to accept.

In response to the invitation of the Executive, the gentlemen whose names appear on the programme very kindly consented to prepare papers for this Convention. In variety of subject and ability of treatment, it is believed these papers leave little to be desired, and that their authors will receive the recognition which their valuable services on behalf of the Association merit.

Some interesting data regarding the electrical industries in Canada has been collected by the Committee on Statistics appointed for that purpose at the first Convention, and will be laid before the Association at this meeting.

To Capt. Carter, Mr. W. A. Grant, manager of the Niagara Falls Park and River Railway Co., the Niagara Navigation Co., the Niagara Falls Business Men's Association, and Mr. Burbank, chief engineer of the Cataract Construction Co., the thanks of the Association are due for the pleasant and profitable outing which is in prospect on Thursday.

During the past year the membership of the Association has increased from 109 to 133.

The following is a statement of the receipts and disbursements for the Association year ending 31st May, 1893:

Receipts.

Cash on hand, June 1st, 1892		$ 20 25	
Cash in bank " " "		199 99	
41 active members' fees		205 00	
14 associate members' fees		28 00	
Balance of active fees for W. A. Tower, J. H. Greer, E. B. Merrill and Geo. Sadler		12 00	
Cheque from Bell Telephone Co.		25 00	
" " G. N. W. Telegraph Co.		25 00	
			$515 24

Disbursements.

Expenses of Convention at Hamilton		$ 94 00	
" " " " Toronto		61 00	
Use of chairs	$ 1 00		
Daily papers, etc	70		
Fee to waiters	6 00		
Fee to caretaker	5 00		
G. S. McConkey	47 00		
Rent of Walker House room	2 00		
Reporting proceedings at Convention at Hamilton		20 00	
Reporting proceedings at Convention at Toronto		30 25	
Grant to Secretary		25 00	
Postage		17 80	
Printing and Stationery		124 11	
Certificates and badges		32 40	
Register, stamp and receipt book		2 65	
Exchange on cheques		35	
Cotton sign		3 50	$411 76
			$103 48
June 1st, 1893.			
Cash on hand		$ 6.30	
Cash in Merchants' bank		97 18	
			$103 48

Since the first of June last there have been received 33 active members' fees and 13 associate members' fees, making the cash balance at the present time $275.23. The fees now due and unpaid amount to $243. Members who have omitted to pay their fees for the present year are urged to hand the amount to the Treasurer at as early a date as possible.

The report of the Commitee on Statistics was read by Mr. Yule. The report was stated to be incomplete owing to the failure of a number of electric companies to respond to the committee's request for information. In view of this it was decided to accede to the committee's request for an extension of time in which to collect further data necessary to complete the report, and in the meantime that the incomplete figures should not be made public.

The President then called for anything under the head of general business which members might desire to bring forward. There being no response, he called upon Mr. F. C. Robertson, who read the following paper:

SOME OF THE CAUSES OF INTERRUPTION TO TELEGRAPH CIRCUITS.

BY F. C. ROBERTSON.

A telegraph system, with its lines stretching over country in different directions, connecting cities, towns and villages, is to some extent at the mercy of the elements; with its batteries, instruments and wires, it is constantly subject to disturbance from various causes. The substance of this paper is a brief description of some of the common forms of interruption (usually called "troubles") which are experienced on telegraph circuits.

The troubles usually met with in the operation of telegraph circuits are of three kinds, and are known as "the break" (or open), "the ground," and "the cross.' The circuit is said to be "open" when its continuity is broken and the current prevented from circulating, "grounded" when there is an abnormal electrical connection between the ground and the earth, and "crossed" when the line is in connection with another line upon which there is a current of electricity.

A circuit may be opened in various ways, for instance, by the breaking of the line, breaking of the magnet wire of a relay outside of bobbin, a loose connection at a binding post, displacement of plugs in switchboard, or by a key being accidentally left open. A break in the line wire generally occurs during very cold weather when the wire is contracted by the low temperature, causing a greater strain in it, and is often found at a point where the wire had been kinked, or at a joint which in making had been twisted so tightly as to cause the wire to be partially severed. Breaks are frequently caused by a tree falling on the line, which usually takes place during a violent wind storm, although sometimes through carelessness of woodmen in felling trees. Sleet storms are very destructive to the lines, owing to the excessive weight due to the ice adhering to the wires, which frequently causes them to break, or the alignment to become distorted. Poles carrying a large number of wires have frequently been known to break down under the extraordinary weight due to ice on the wires. Sleet storms general over a large area of country, of such severity as to damage lines, are fortunately of rare occurrence. The circuit is sometimes found to be open in an office, and might be traced to a broken connecting wire, broken relay wire, loose binding screw, but more frequently to an open key, or a plug out of position in switchboard. The circuit is sometimes found to be open in the battery, due to a jar breaking and allowing its solution to escape, a zinc falling from its hanger to the bottom of the jar, or the wire connected to the copper element becoming detached. There is a kind of trouble which takes the form of an extraordinary and variable resistance in circuit, which is sometimes met with on old lines, the source of which usually is a rusted joint, or a joint on a portion of the line in which there is no tensile strain. During dry weather these joints cause the resistance of the wire to be much increased, but during a rain the joints become wet, improving their conductivity.

Grounds on the wires are of more frequent occurrence than breaks or crosses. All ground faults contain more or less resistance; when the resistance of a fault is very small, the connection of the line with the earth caused thereby is comparatively perfect, practically dividing the line at that point into two circuits and preventing the current from the battery at either end of the line from passing further than the fault, but when the fault contains considerable resistance the connection with the earth caused thereby is not sufficient to prevent a portion of the current from either battery from passing the point of fault, the working margin of current being that which finds its way past the point of fault. The circuit in such case is not totally interrupted and signals may be exchanged between terminal offices on the circuit by properly adjusting the receiving instruments. Such a fault is called a "partial ground," or more commonly termed an "escape."

Although "single" (or simplex) circuits may be worked fairly well with a considerable and varying escape on the line (as the adjustment of receiving instruments can quickly be changed by the operator to correspond with the variations of the current), quadruplex circuits cannot be worked successfully under the same conditions; the varying escape causes the balance of the instruments to become disturbed, producing a mutilation of the signals on the receiving instruments.

A large percentage of the number of grounds which occur are found either on the lines in the towns through which they pass, or in the offices, only a small proportion being found on the lines in the country. The wire coming in contact with a foreign wire, such as a telephone, call bell, or guy wire, is a very frequent source of the trouble, though the circuit is very often grounded at the switchboard during a thunderstorm by lightning fusing the metal at the air-gap of the lightning arrester in passing over to ground. Partial grounds, or escapes, are often due to the wire touching the branches of trees, and are more susceptible during wet than dry weather, the effect of the moisture being to magnify the escape. Highway lines are more subject to escapes of this kind than lines located on the right of way of a railroad, owing to the numerous shade trees which they encounter and the difficulty experienced in keeping them trimmed to clear the wires; owners of the trees as a rule object to any extensive cutting of limbs which would tend to disfigure the appearance of the trees, consequently to maintain a clearance the branches have to be frequently pruned. If this operation were neglected for a long time the effect would be manifested by the insulation of the line deteriorating. In cases where trimming cannot be done, in order to clear the line it becomes necessary either to replace the poles by higher ones, so that the wires will pass above the tops of the trees, or to divert the line by setting the poles out.

Crosses are not of such frequent occurrence as grounds, and in many cases occur through some material defect in the condition of the lines. Wires become crossed usually during the prevalence of a wind storm, which causes them to sway; at long stretches, especially where the wires happen to be slack they more easily cross. Frequently crosses occur in consequence of a pin or tie wire breaking at an angle in the line, an insulator working loose and raising, or a pin being pulled out of cross-arm at a depression, allowing the wire to depart from its parallel position relative to the other wires. Crosses caused by a piece of small wire or other metallic object being thrown amongst the wires often occur, and on account of its obscurity the cross is with difficulty found by the lineman. I know of several instances where wires were found to be purposely connected with a piece of fine wire (evidently by persons bent on mischief), in such a manner that the fine wire could not be seen from the ground. Eventually in each case a galvanometer test was made and the cross approximately located; the lineman sent out to the supposed locality of the trouble was obliged to climb a number of poles before finding it.

When the nature of an interruption is such that the trouble does not remain on the wire constantly, but comes in and disappears again at intervals, it is called a "swing," and when the intervals are long and the length of time the trouble remains is short, the interruption, though of not so much consequence as regards impeding the working of the line, is more difficult and slow to locate than if the interruption were constant.

When two or more wires are crossed one of them can be cleared by opening the others at stations on each side of the cross. In case a through and a way wire are crossed it is customary to clear the through wire by opening the way wire at the stations between which the cross occurs in such a manner that said stations may have communication on the way with their respective terminals and intermediate offices. Such an arrangement is accomplished in the following manner: Suppose two wires, number 1 and 2, running west from terminal station A to terminal station D, are crossed between way stations B and C, of which B is east and C west of the cross. It is required to clear No. 2 (the through wire) and ground No. 1 (the way wire), so that B can work with A and C with D respectively. B opens the west end of No. 1 wire at the switchboard and grounds the east end with instrument in circuit east of the ground, C opens the east end of No. 1 at his switchboard and grounds the west end with instruments in circuit west of the ground, thus that part of No. 1 between stations B and C will be "dead," causing no interference with the working of No. 2. At the same time the circuit in the portions of No. 1 between A and B and between C and D, will be closed by means of the ground connections.

Lightning coursing the wires during a thunderstorm has a strong tendency to do damage to the instruments, and were it not for the presence of that valuable arrangement called the "lightning arrester" (which forms an adjunct to modern cut-outs and switch-boards), many relays would be burned out. Before the lightning arrester was invented the custom was to cut out the instruments during a thunderstorm, but now it is considered quite safe to leave the instruments cut in, regardless of the storm, where the switch-board is provided with this protection, and it rarely happens that a relay is found to be damaged by lightning. The tendency of lightning to do damage is not confined to the instruments alone, poles on the line in the country being shattered and cross-arms splintered. In this connection it may be apropos to remark that the custom of modern line builders to provide the poles at intervals along the line with ground wires may be regarded as commendable; the arrangement appears to give good results in the capacity of lightning-rod protection to the poles.

Office main wires, especially if insulated with paraffined cotton covering, where allowed to rest in contact with a gas pipe or grounded object, are liable to become grounded by lightning penetrating the insulation and carbonizing it in its path, producing a conducting medium and creating a permanent connection between the main wire and grounded object.

During the brilliant display of luminous streamers exhibited in the heavens occasionally, and known as the Aurora Borealis, the telegraph circuits throughout the continent are more or less affected by earth currents, which become so severe at times as to entirely interrupt communication. These earth currents constantly vary both in intensity and polarity, making it impossible to keep the instruments adjusted on circuits having an earth return. It may be of interest to mention that some tests were made by Mr. William Finn, of the Western Union Telegraph Company, on a No. 6 gauge iron wire 213 miles long, extending from New York to Boston, during the magnetic storm of July 16th, 1892, which showed that the abnormal current in the wire reached the strength of 133 milliamperes, and the maximum difference of potential of the earth at New York and Boston was 492 volts—such a high voltage had not been observed during any previous storm. A wire can be worked during a magnetic storm by disconnecting the ground at each end and substituting a wire return instead, thus forming a metallic circuit. I beg here to state that a quadruplex circuit arranged with a metallic return was successfully worked by the Canadian Pacific Telegraph Company between Toronto and Montreal during the magnetic storms of last year.

The foregoing mentions only a small portion of the troubles to which telegraph circuits are subject; to enumerate all would occupy much space and time.

In conclusion I beg to mention a few conditions which, when complied with, have a tendency to prevent trouble to a great extent. The line should be constructed in a substantial manner, only first-class material being used. Poles should be sufficiently stout in proportion to their height, set well in ground, placed close enough together to render the spans not too long, so as to well support the wires and to prevent them from crossing. At corners the stretchers should be much shorter, the poles well braced or guyed, double cross-armed and straight grained pins used. The wires should be stretched tight and the joints soldered. At crossings of other lines it is best to go above them, but if this cannot be conveniently done, the wires in passing underneath should have a good clearance and be protected by guard wires to prevent other wires from falling on them. At a low point in the line where there is an upward strain the pins should be nailed in, and loops or hooks secured to cross arm over each wire so as to catch it in case it should raise through an insulator coming off pin or a tie-wire breaking.

All limbs of trees liable to come in contact with the wires should be removed. Special attention should be given to the wires in cities and towns to guard against crosses with electric light or railway circuits. Office cut-outs and switch-boards should be provided with lightning arresters, and the wires where they enter terminal offices be supplied with automatic line openers to act in case a cross with an electric or trolley wire occurs. For inside wiring it is preferable to use waterproof insulated wire, but if paraffined cotton covered wire be used, it should not be laid in grooved boards, but secured by cleats and placed where it will be free from moisture, and where the insulated covering cannot become abraided. The batteries should be placed in a dry place easy of access for frequent examination. Binding screws should be examined occasionally to see that they do not work loose. A vigilant and industrious lineman will prevent the occurrence of much trouble by frequent and careful examination of the lines in his charge, making repairs promptly when required and keeping the lines generally in such shape that the apparent liability of their becoming interrupted is reduced to the minimum.

DISCUSSION.

Mr. A. B. Smith expressed his satisfaction with the paper, but the writer had not touched upon some of the interruptions to which telegraph lines are subject, such as those occasioned by electric light and trolley wires. He could not help thinking while hearing the paper read, of the old days before these sources of interruption existed, and how much easier it made things. Many would be surprised to learn that in the large offices during lightning storms the instruments were not cut off, notwithstanding which it was very a rare thing for them to lose an instrument. He heartily concurred in Mr. Robertson's remarks regarding paraffined wire; he was himself of opinion that it should be absolutely prohibited.

Mr. Nicholls said the thanks of the meeting were due the last speaker for his efforts to set the ball rolling by discussing the paper, and thought Mr. Smith might go further by giving some data with regard to what was a new adaptation of electricity in this country. He understood that the G. N. W. Telegraph Company had discarded batteries in its Toronto office, and was now running the telegraph instruments by means of motor generators, The problem had been a most interesting one theoretically, and he felt sure if Mr. Smith had not time now or if the subject was too intricate to be disposed of in a few words, he would favor the Association at some future time by preparing a paper on the subject, which he felt sure would be heard with great pleasure.

Mr. Smith said that some remarks of his on the motor generator, which was now really becoming an old subject, would be found in the report of the last convention.

The President suggested that Mr. Smith might invite the members of the Association to inspect the system now used.

Mr. Smith expressed his entire willingness to do so at any time convenient.

Mr. Nicholls inquired how many thousand batteries were displaced by the two small motors in use.

Mr. Smith replied that they had been using about 2000 cells, but that was very small. In Buffalo they had something like 15000 cells, and he would undertake to do their work with the same plant in use here.

Mr. L. B. McFarlane, referring to that part of the paper in which was mentioned the working of a quadruple circuit arranged with a metallic return, said he thought that was the first time it had been successfully accomplished in Canada. If he remembered correctly, it had been done not only between Toronto and Montreal, but between Winnipeg and Montreal. This was something quite new in telegraphy, and he thought much credit was due to the C.P.R. people. The interruption caused by the magnetic storm was so great that they were unable to work their ordinary lines, and they sent a man north of Lake Superior to make tests, and succeeded in working the system. This afforded them great relief, and enabled them to work their lines when they could not have done so under the ordinary conditions. It was also stated in the paper that a wire could be worked during a magnetic storm by disconnecting the ground at each end and substituting a wire return. It had always been held that that was possible, but he believed that in the last storm it was found ineffectual, and therefore some other method would have to be found. He had much pleasure in moving a vote of thanks to Mr. Robertson for the very valuable paper he had contributed.

Mr. Black in seconding the vote, said very many of the interruptions spoken of were due to causes of comparatively recent origin. There had been a time when such a thing as switchboards and lightning arresters were rare.

The vote of thanks having been carried, the President introduced Mr. A. C. McCallum, of Peterboro', who read the following paper :—

TURBINE WATER WHEELS.

BY A. C. MʻCALLUM, M. E.

Turbines when correctly designed and constructed are by far the most efficient motors for the utilization of water power, and on account of their comparatively small size, moderate or high speed, regularity of motion and the slight amount of gearing required, are superior in every respect to the ordinary water wheels of the overshot, breast, &c., class.

The turbine water wheel was the invention of Fourneyron, of France, in 1827, and was introduced into this continent some time later by Mr. Ellwood Morris, an engineer of Pennsylvania. Since that time there have appeared before the public numerous varieties of turbines, each inventor claiming for his wheel improvements over that of his predecessors.

There are many types of turbines, good, bad and indifferent, so that in the choice of one we should not be guided solely by catalogues representing one particular design. Many turbines give fair or good results when working under the full supply of water, but the majority are nearly useless when working at part gate, at say below half gate, hence on streams subject to fluctuations it becomes a matter of primary importance to select a motor that will give a high efficiency not only at full gate opening, but also at all stages of gate opening.

A turbine water wheel consists essentially of a ring to which are attached curved vanes or buckets, arranged uniformly round the circumference, revolving on a shaft to which is keyed the hub or boss of the ring. This is encircled by a case in which are placed the chutes or guides, and by means of which a whirling motion is imparted to the water; over this case is placed the dome, or covering of the wheel which, together with the short suction or draft tube in which is to be found the step upon which the wheel or runner is carried, go to make up the wheel. All turbines are made more or less after this fashion, and yet there are hundreds in which the difference is only slight, and yet the percentage of useful effect developed by them, when under test, has shown from 40 to 90 per cent. of useful effect, and from the fact that most streams in our country are subject to fluctuations in the volume of water, it is necessary that in placing turbine wheels from which we derive our motive power, that we place a turbine capable of developing a high percentage of useful effect whether working at part or full gate.

All turbines so far as the behaviour of the water in them is concerned, belong to one of two systems: 1st. That in which one works with all its parts entirely drowned or full. 2nd. That in which free deviation of the water, and the admission of air to the buckets is required for the proper working of the wheel.

These systems or classes are known among turbine water wheel builders as reaction wheels in the former, and impulse in the latter. In reaction turbines it is required that there be a continuous flow of water to the buckets of the wheel; and they can be successfully used with a draft or suction tube, which in many cases, overcomes obstacles to the successful working of the wheel.

In the case of impulse turbines the buckets are only partially occupied by the water passing through them; the atmosphere has free access to the remaining space, so that the feed to the wheel always takes place under atmospheric pressure. Usually both reaction and impulse turbines are provided with guides or chutes, from between which the water enters the buckets of the wheel, and by means of which the water is caused to enter in the desired direction.

All modern turbine water wheels are constructed after one of three types, or of some combination of these types. They are: 1st. The outward flow wheels. 2nd. Inward flow, or centre discharge wheels. 3rd. Parallel flow wheels.

In the outward flow wheel of which Fourneyron's reaction wheel is the earliest type, the water flows usually through a pipe or conduit, and is diverted from its course in an outward direction by means of fixed guides or from the axis of motion; the form of these guides gives the water a whirling motion upon entering the wheel.

In the inward flow the water flows first in the direction of the axis, usually downward, and is then diverted by fixed guide blades inwardly or towards the axis of motion, the fixed guide blades giving the water a whirling motion as it enters the wheel.

In the parallel flow type the water moves parallel to the axis of motion before and after it passes through the wheel, the fixed guide blades again imparting a whirling motion to the water.

These types of wheels are best illustrated; in the first case, that of outward flow wheels, the Fourneyron wheel may be taken; there have been many modifications made upon this wheel, but they are all of the same, and the same principle applies to all. This type finds its greatest field in France where it originated, and is not used with a draft tube.

In the second case, that of inward flow or centre discharge wheels, the "Rose," the "Francis," "Centre Vent" wheel and others—in this type of wheel the guides or chutes have simply changed places with that of the wheel, the former being placed outside or concentric to the latter. From this type of wheel has developed that of the combined or mixed flow turbines, in which the previously named systems are combined. It is easy to see how this has taken place, for by a continuation of the guides into that part of the wheel where the water assumes a vertical direction, the radial flow is changed to that of an axial flow while the water is in the buckets, instead of after it has left them, and it is of this type or combination that the leading American wheels are built, and of which class anything I may say will mostly be directed.

In the third case, that of parallel flow turbines, this type is generally illustrated by that of the "Jouval," so named after the engineer who first introduced them; they are more extensively adopted in Europe than any other type of reaction wheel.

The adoption of the combined or mixed flow turbine, by American engineers, would appear to be caused by the large volumes of water at their disposal. Economy of water was second to that of first cost of the wheel, and yet their principal aim has been to construct a turbine of the smallest possible diameter, and yet develop the largest amount of horse power for the amount of water consumed. How far they have succeeded in this is shown by the efficiency course table exhibited. Impulse turbines seem to have been discounted by American engineers and such is perhaps due to the fact that reaction wheels, when running at their best possible speed, and using the full volume of water for which they were designed, develop a better percentage of useful effect than that by the impulse type of wheel. Each of those classes of wheels have their useful spheres, and to point out which I am afraid would take up too much of your valuable time.

One of the important features of a turbine water wheel is the curves or forms of the buckets, and in the construction of which it must be confessed that the American inventor's plan can only be called that of the "cut and try" method, while the curves of wheels constructed in Europe have been mainly perfected by careful study and mathematical reasoning, the result of which is, that the guides and buckets are of the best shape in the type of wheels they build there.

In the case of an American engineer, should he look to the works of Rankin, Weisbach, Bresse and others, for suggestions that would help him in the construction of a wheel, he would look in vain. In the construction of turbine wheels the bucket shapes have depended entirely upon the whims and notions of the inventor. He makes his wheel after his idea, has it tested against some old timer; changes are perhaps made first in one part and then in another, and so on until the wheel is brought to a stage of perfection satisfactory to the engineer or inventor. From results that have been obtained from wheels of all shapes of buckets, that shape in which the bucket at its upper part recedes from the water, gradually curving downward, and then receding backward in a direction at almost right angles to that of the bucket's upper form, has given the best results, and wheels with the double bucket device do not attain the same proficiency. In a vertical section of a bucket of this kind, the line of the bucket facing the water or termed the receiving side would be somewhat parabolic in shape, the buckets would be so placed upon the hub or cone of the wheel as to be almost tangent to that body. The discharging point of the bucket or lower part, and in which the reaction of the water mainly takes place, is so made that the water in discharging from the bucket will be delivered in greatest volume from the outer radii of the wheel. The back of the bucket at its top part requires the placing of what is termed a "Y"; this prevents any water from being lodged there and carried round by the wheel, which would be simply load carried for no purpose although such might not be much. The idea of forming the bucket with a downward curve is, that the friction of the water passing downward against the buckets is helpful, together with that against the cone upon which the buckets are placed, in easing the weight off the step upon which the wheel is carried; wheels constructed after this fashion are not troubled much with steps that burn out, a source of great annoyance to the user of such wheels as this occurs in. Buckets in which the upper part presents a vertical plane to that of the inflow, have often proved to be injurious to the wheel, because of the fact that the friction of the water acts upon the bucket in a contra direction to that in a bucket where the top part is curved in a direction to the motion of the water.

Wheels with buckets constructed upon the former lines have made the best tests of any kind yet made. We have the "Victor," "Hercules," &c., which have developed in sizes of wheels of from 15" to 48" diameter, from 82 to 89 per cent. of useful effect, and when it is considered that many wheels do not develop more than 60 per cent. of that of the power due the head under which they work, wheels of this build must find favor with water wheel users who do not consider the first cost the essential feature in wheels.

Turbine buckets have been and are made of sheet iron, steel plate, of brass and of bronze, but experience has shown that wheels in which they are of one homogeneous casting are the best that have yet been produced. Wheels in which the buckets together with the band are made separately from the cone or hub either of cast or wrought iron, are decidedly the worst kind. Wheels built this way often have the buckets shear off, whereas, in the wheels of one casting, this never takes place, providing the wheel is properly proportioned.

Care should be taken in purchasing a wheel to see that the discharging orifices of the buckets are all of one area; wheels in which these orifices are not of a uniform area produce effects not at all to be desired when imparting motion to a dynamo; irregularity of speed, and not being easily controlled by a governor, are points to be considered by the purchaser.

The distribution of the water as well as the direction and velocity of flow must be taken into account, and this leads me to another important part in the construction of turbine wheels, namely, the method of regulating reaction turbines. There are various methods of doing so: we have wheels placed in scroll cases, in which the water is applied to the wheel through a single long chute which extends in a continual narrowing radius around the wheel. Such constructions are subject to serious defects. Owing to the manner of the application of the water the step is almost in all cases worn to one side; this defect is caused by the pressure of water being greatest at the first point of contact and growing less as it passes around the wheel. Wheels with cases of this style generally have adjustable steps to permit of their being centered, a feature which is not necessary in wheels in which the water is applied at all points in equal volume. The method of regulating the water at part gate is faulty, similar to that of throttling a steam engine. By means of a large gate the water is admitted or shut off from the wheel. This gate being placed at the outer end of chute or case, the water when admitted at part gate, immediately upon passing the gate in this style of regulator, has a great expansion and breaking up of the water, and in which the diminution of pressure and velocity is much greater than would occur from a corresponding loss of head, and perhaps their only redeemable feature is their first cost. Another method of regulation is by means of what is known as fly-trap or hinged gates, which consists in attaching the guide vanes to pivots, so that by changing their inclination with respect to the wheel, the area of the guide passages can be varied at will.

One of the objections to gates of this kind is, that in all positions of the guides but one, the water enters the wheel with impact, the result of which causes a corresponding loss of energy.

In the construction of this gate many parts are required; the tendency is to wear and become leaky. The rods and other devices used to operate the gate, sometimes bend and wear until they fail to open the gate but partially. The Leffel, the Success, the Angell, of Providence, R.I., etc., illustrate this style of gate.

Some wheels are regulated by means of a cylinder gate, a round hoop or band, like the rim of a pulley, which is raised or lowered either outside or inside of the stationary chutes that direct the water on to the wheel when the gate is out of the way. The advantages of such a gate are simplicity, strength, durability and tightnes when closed. Defects are found in them to quite an extent.

They are hard to govern, have to be counter-balanced by means of weights, and usually require high decking over the wheel case to cover the gate when it is raised, adding to the cost of the wheel. The stationary chutes of this class of wheel are easily clogged by means of weeds, sticks, leaves, &c., which become wedged into the narrowest part of the wheel. The guides not being moveable, this rubbish can only be taken out by hand, a very disagreeable task.

This type of wheel gives very good percentage at from full to part gate. The "Hercules" and "Risdon" are fair types of this kind of gate. This style of gate is not, however, suitable for this country, Canada. Especially in the winter here are our streams subject to anchor ice; and these wheels between the stationary guide get packed solid with anchor ice, and require the application of muscular force and crow-bars to make a clearance, a task not to be entreated on a cold winter's day,

The last style of gate I shall mention is that of the Register gate which consists of a ring or cylinder, fitted concentric between the stationary guides and the wheel, and containing a series of openings corresponding to that of the orifices of the guide passages, and by turning the regulator cylinder the guide passages can be covered. This style of gate contains all of the good points of the other styles of gates, and is found to have fewer defects than the others. It has the least number of parts, is of great strength, is always a tight gate, is not easily clogged, for the movement of the register will usually release any obstructions that will pass through a properly constructed rack. Gates of this style give perfect admission of the water to the buckets at full gate, and maintain a good result at part gate.

Wheels with gates of this type have few tender parts, and practically nothing to wear and are easily governed, not subject to be choked by anchor ice, and are probably the nearest to perfection of any type of wheel built. It is often argued against this type of wheel gate that they do not give the same percentage of useful effect as some of those built with fly-trap and cylinder gate. You will notice by the efficiency curves of the different types of wheels what they are doing. They are characterized by fewness of parts, simplicity of construction, and above all are not easily clogged, and can be closely regulated. This gate tends to close itself by the action of the water, which is a desirable feature where close regulation is demanded, as in electrical work, and the cost of the motor, even if 3 or 4 per cent. is wanting in efficiency, at part gate; they will still recommend themselves to users of water power in this country as the best type of water wheel of any built for all round work. Wheels of this type are best illustrated by the "Victor," the "Boss," the "Flenniken," and others.

I have endeavored to present to the members present an impartial sketch of the American type of turbine wheel. Some of my remarks may be open to criticism; they are entirely founded, however, upon practical experience amongst water wheels, and as one finds things so must he speak. But I can hardly leave off here, and yet I fear I encroach upon your good nature, for the placing of our turbine is a most important matter. It seems to me that this matter is one which all users of water power should be thoroughly acquainted with. The necessity of large tail race and wheel pit is of great moment to the success of the turbine. There are many wheels upon the vast number of streams on this continent that are developing only from 40 to 60 per cent. of useful effect, when 70% to 80% or more might be obtained if the wheels were placed properly, and the flumes and penstocks were of proper dimensions.

No hard and fast rules can be given to regulate the dimensions of the flume, penstock and tail race.

In many instances where the head is high or moderately so, the adaptation of turbine wheels on horizontal shafts has been successfully carried out, and without any sensible loss of power by this arrangement, and when it is considered that the loss of power by transmission through gears is wholly saved, and no loss of head is sustained by the use of the draft or suction tube, the advantage of this arrangement must find favor with electrical engineers. In situations which admit of the use of turbines mounted upon horizontal shafts, they make a specially desirable arrangement for driving dynamos, the power being generally transmitted directly by straight belt to the motor from the wheel shaft, the neat appearance and small space occupied by them, and the ease with which repairs can be made to them, are advantages that more than compensate for the extra cost in the first place. In fact nearly all moderate or high heads which are used to develop power for electrical purposes are having horizontal wheels placed.

For many kinds of work where the changes of load are light or where there is a considerable load upon the wheel at all times, there is seldom a wheel that cannot be successfully regulated. But when the load is subject to heavy changes, and at times only a small per cent. of the power is used, as is frequently the case in electrical work, it then becomes important that the wheel should have a proper gate and run at a proper speed.

In order that the governor may act upon the gate without loss of time, it is necessary that the gate and its connections should have little or no lost motion. Those gates are to be preferred which tend to close themselves, either by their own weight or through the action of the water. Good results may, however, be obtained with others where the lost motion is reduced to a minimum.

Another point not generally understood but which has an important effect upon the regulation, is the speed at which the wheel is run, depending, of course, upon the size of wheel and head under which it works. In order to control a heavy change of load with the least variation of speed, it is necessary that the governor should operate the gate as quickly as possible without running by or racing. Now the faster the wheel runs the faster the governor may be made to operate without danger of racing. Ten per cent. increase in the speed of the wheel, will permit of the governor operating nearly twice as fast. Again, the faster the wheel runs the less it will be affected by a change of load. Given any water wheel and any head of water, there is a speed at which it will develop the most power. It will readily be seen that if the wheel is running at a speed above this point of maximum efficiency, when the motion is reduced by an increase of load the efficiency will increase and tend to retard the reduction, while if the wheel is running below this point of maximum efficiency, the efficiency will be reduced by any reduction in speed and tend to further reduce it.

The speed of the periphery of the wheel should be about 65 to 70 per cent. of the velocity of the water due to the head acting upon the wheel.

The greater the load upon the wheel at any time the easier the regulation becomes, so that, while in many cases wheels may be successfully regulated while running somewhat below the tabled speed of the builder, in others, where the load on the wheel is very light at times, it becomes important to have the wheel run fully up to the tabled speed. When the load is subject to sudden and heavy changes and good regulation is important, as is the case in electric railway work, it is sometimes advisable to run the wheel considerably above the tabled speed, although some loss in economy of water may result from this.

I had no thought when I began my paper that it would extend so. I had hoped to give many useful rules regarding water power, wheels, flumes, &c., not generally known among users of water power, but time will not permit. I trust that some of my remarks on the subject may have been interesting and profitable; if so I feel that I am more than repaid for the time spent in writing upon this subject.

DISCUSSION.

The President said the subject of the paper just read was one which might become of considerable importance in Toronto when the big ship canal now being talked of became something more than the figment of the imagination it now was.

Mr. Rosebrugh said he had heard it stated that in the case of electric railways, especially in small towns where only a few cars were used, trouble was experienced with the regulator, the effect being that when the cars were all stopped the turbine was running at its highest speed, the regulator never being rapid enough. He desired to know if the regulator could be made to do better than that, or if any other means were known of making the regulator keep pace with the turbine.

Mr. McCallum replied that he did not think it possible with the style of regulator in use. The only way it had been successfully operated was by speeding the wheel up, and then there was a loss of power while speeding up. He thought that if the wheel was speeded up and the governor applied in the way he suggested that it might be successful. Still, in a small town where there were only four or five cars, the trouble of regulating would always be a serious annoyance, and he fancied there would be no method of controlling it except from the motor itself, and from that it would be necessary to regulate back to the wheel again instead of using the ordinary governor on the shaft driven by the water wheels.

Mr. H. O. Fisk inquired what was meant by "speeding up" a wheel. Did Mr. McCallum mean to put in a larger wheel than was ordinarily required?

Mr. McCallum answered that most builders of water wheels tabled their wheels to run from 65 to 70 per cent. of the head under which the wheel was working, and of course the gear applied to the wheel between the wheel and the pulley shaft was placed so that the speed might be brought down to the proper place on the table; so the only way would be to put a smaller gear on and bring it to a higher speed.

Mr. Galt said he thought it would be known to anyone present who had a little experience in water wheels that the water wheel was a very imperfect machine for the regulation of power. In past times water power had been very valuable, but with the great improvements in machinery and the greater economy and perfect regulation with which steam engine boilers are at present run, water wheels had become less desirable. The design of a water wheel was to have a head of water, and this water had to fall in a vertical direction. Wheels had been largely designed to operate vertical shafts, and therefore the water in coming downward had to exert its force in a horizontal direction, and consequently to descend upon it in the current direction forward and back in the out-flow. More time and money had probably been spent in experimenting on this type than any other form of water wheel. He was sorry that Mr. McCallum had not included the Pelton water wheel, which was capable of being used with great efficiency and regulated fairly satisfactorily for electrical work. The question of regulation was one of some importance to electrical engineers, because a certain degree of regulation must be obtained, and that was where so far it had failed. At Ottawa and other places it had been seen that the services of some person are constantly required to assist the regulation. Water being an incompressible fluid, it was impossible to bring it up in the same way as a steam engine could be regulated. A certain amount of regulation could be obtained, but in addition to that automatic regulation, attendance was required, which was a somewhat objectionable feature. He believed it was the experience of all who had used water power for any great length of time, that although the very large first cost was somewhat against steam, taking all things into consideration, if they had the same thing to do over again they would go back to steam power. He did not desire to speak disparagingly of water power or water wheels, but merely to show that in this aspect they were not viewed as favorably by electrical people as a steam engine plant. He would not say that improvements would not be made which would render water wheels valuable; very large central powers developing and transmitting for long distances might eventually become very serviceable, but for isolated plants, distributing power over small areas, he did not think water power possessed the advantages imagined by some people. There had been a great deal of talk about the project referred to by the President, the Hurontario ship canal, which they all knew was mere folly. Mr. McCallum's paper is one well worthy of the attention of electrical engineers who in their practice meet with prime movers of this kind generating power for electric lighting and street railways. Having himself had some experience in putting in power at different places, it was his conviction that steam was preferable to water power, although in places having water powers people sometimes felt insulted at any suggestion of not utilizing that which was the pride and glory of the place. In connection with electric lighting, where water power was utilized, the question of regulation was a source of annoyance and expense, yet they were working fairly satisfactorily, but on the whole not to be compared with steam, unless under some special circumstances.

Mr. A. A. Wright inquired what Mr. McCallum meant by "burning out," and also what was to be understood by a double bucket.

Mr. McCallum explained that the step upon which the wheel shaft rested was made of lignum vitae, and that the more easily the wheel sat upon it the less liability there was of its burning out.

Mr. A. A. Wright asked if water wheels had ever been made of aluminum.

Mr. McCallum had not heard of such being the case. He believed that American engineers would before long depart from the principles they had followed, and would adopt impulse as the motive power; wheels of the kind were being brought to the tunnel station at Niagara Falls, of the Swiss pattern. These wheels were found very useful in Switzerland, where they had large heads and small volumes of water.

Mr. Galt said where larger heads and smaller volumes of water were the rule, regulation could be reduced to a finer point; but in many cases in Canada the condition was large volumes of water passing through a wheel of large diameter, and regulation was consequently difficult to attain.

Mr. Fisk asked if it was not the best practice to drive two separate wheels on one shaft instead of regulating on the one wheel.

Mr. McCallum said it was found that wheels of small diameter gave a better percentage of useful effect. Two wheels of 30 inch diameter gave a better percentage than one of 60 inch or 70 inch diameter working to the same head. The best plan seemed to be to divide up the power. In Gananoque, where he had been designing a plant for Mr. Campbell, they had put in two smaller wheels on a horizontal shaft, which he believed would operate very successfully.

Mr. Fisk said he had been running a plant for seven years, and had experienced no trouble as far as lighting was concerned, although, of course, there was more trouble with power. He believed, however, that before long a governor would be devised to obviate the trouble. He could not see why a machine could not be made to do what a man could, and with a man who understood his business at the wicket, the voltage could be kept within fifty volts—from 500 to 550—without any trouble.

The President said that the question of water powers was coming into more or less prominence owing to their utilization and the transmission of their force for long distances. He was glad to find that there were one or two present who endorsed his ideas in regard to the relative value of water and steam powers—that there was very little to choose between them when it came to driving electrical apparatus.

On motion of Mr. Galt, seconded by Mr. Wright, a vote of thanks was accorded to Mr. McCallum for his paper.

The President called attention to a notice by Mr. Carroll that the term of office of members of the Executive Committee be one, two and three years, instead of the whole board retiring each year, as at present.

The meeting then adjourned, to meet again at 10 a.m. to-morrow morning.

SECOND DAY.

MORNING SESSION.

The President called the Convention to order at 10:30 a.m.

He then stated that the motion of which notice had been given yesterday would require, in order to be introduced, a two-thirds vote of all the active members present. It was moved by John Carroll, seconded by D. A. Starr, that the term of office of members of the Executive Committee be one, two and three years instead of the whole board retiring each year as at present. Was it the pleasure of the Convention that the motion be introduced.

Mr. Fred. Nicholls: It might be interesting before voting on the amendment to have it explained, and the reason given why the change was regarded as desirable.

The President said it was unfortunate that the proposer of the resolution was not in the room. He himself always made it a point in cases of this kind to go straight ahead; if the persons who desired the change were not present they should take the consequences of their absence. He thought the Convention should not wait for any individual member. However, if they felt disposed to hold it over to a later stage it could be done.

Mr. Nicholls said he thought Mr. Starr was the mover of the resolution.

Mr. Starr replied that he was only the seconder.

Mr. Nicholls thought the amendment of any part of the constitution of an organization was always a more or less important matter. Some of the members did not know what were the advantages to be gained by the change, and would like to hear the reasons and arguments in its favor, so that they might not vote upon the question blindly.

Mr. Starr said he thought Mr. Carroll's intention was simply to follow generally existing precedents in such matters.

Mr. Kammerer said he had had some conversation with Mr. Carroll regarding this matter, and he gathered that the object of the resolution was to obviate the possibility of the whole of the Committee going out of office at one time, leaving in the hands of an entirely new Executive unfinished business with which they were not in touch. The plan proposed would result in there always remaining in the Executive two or three members familiar with such business.

Mr. A. A. Wright saw both advantages and disadvantages in the proposed change. There was the possible contingency that a man might remain in office for three years who would not do anything, which would be a disadvantage. The advantage was that a man acquainted with the routine of the work grasped the subjects being dealt with more readily than could a stranger. The method proposed by the resolution was the one followed in High and Public schools. As for himself, he did not think he should vote either way.

Mr. Nicholls thought there was a great deal in the argument advanced by Mr. Kammerer, that it was usual for Executive Committees to be elected in a manner similar to that proposed, but, as Mr. Wright had pointed out, it would be quite possible to clog the wheels of progress by electing to office for three years members who failed in their duty to the Association. On the other hand, if through any combination of circumstances it should happen that an entirely new and inexperienced committee were elected, the members having no previous knowledge of the projects of the Executive then in progress, it would be a great disadvantage. He would suggest as an alternative that the members be elected for one and two years, so that there would always be a sufficient number to carry forward any year, but no one would be elected for a term long enough to enable his possible inattention to hamper the business of the Association.

The President said that while the constitution was being amended in this respect, it was within their province to alter the number of members, and make it either eight or ten.

Mr. Nicholls said, that being the case, he would move that the number be increased to ten, five of whom should retire each year; any or all of these retiring members might be re-elected if it was the pleasure of the Association in general meeting assembled.

Mr. Kammerer seconded the motion.

Mr. Carroll inquired if it was not necessary to have a notice of the motion.

Mr. Nicholls rose to a point of order; the proposal was an amendment to a motion of which notice had already been given.

The President ruled that the objection was well taken. He then put the amendment as follows:

Moved in amendment by Mr. Fred. Nicholls, seconded by Mr. Kammerer, that the number of members forming the Executive Committee of the Association be increased to ten, five retiring each year, and five members to constitute a quorum.

Mr. Starr pointed out that in that case, there being ten members, either five of them might form a quorum.

Mr. Carroll said the Executive Committee of the National Electric Light Association was composed of nine members, which seemed enough to carry on the business. Their plan of election was for two and three years.

Mr. Nicholls said that the Canadian Electrical Association, being a new organization, many of the practices of older Associations might prove neither desirable nor wise in it. It was desirable to centre as much interest in the Association as possible, and this would be effected by having as many as possible of the eligible men engaged in various electrical enterprises executive officers of the institution. The territory to be covered was very wide; it was the aim of the organization to be a Dominion Association, though he thought all would admit that at present it had not assumed much more than a Provincial character. There should be offices enough so that when another province was found taking an active interest they would go all round.

Mr. Taylor said he would like to ask the President how the Executive Committee meetings had been attended.

The President said there had usually been a quorem in attendance, but that was about all.

The amendment was then put and carried.

NEXT PLACE OF MEETING.

The President announced that the next business was to determine the place of the next meeting.

Mr. Kammerer moved that the next meeting be held in Montreal. His reason for doing so was that there were a number of members from that city who might be called very active members, who took a very active interest in the Association throughout the year, and whose interest never flagged. He might mention the names of Mr. Carroll and Mr. Starr, who came up for the purpose of attending meetings of the Executive. He thought some recognition of this fidelity might be given by holding the next meeting at Montreal. Last year the matter had been brought up and the Montreal people decided that they did not desire to have the present convention held there, they not being ready at the time as they thought to give such a reception to the Association as they would like. He understood, however, that Montreal was now ready, and was prepared if the convention was held there next time to give the members a good time.

Mr. Nicholls, in order to bring the matter fully before the Association, and to induce a full discussion of the matter, seconded the motion. He thought "the greatest good to the greatest number" was a consideration always to be remembered in matters of this kind.

Mr. A. B. Smith remarked upon the fact that both the mover and seconder were Toronto men.

Mr. Starr said he had had considerable conversation with several Montreal people, directly or indirectly connected with the Association, and he could assure those present that if the next meeting, or any meeting at any time, were held in Montreal, they would have as pleasant a time as it was possible to give them. He thought the reputation of Montreal as an entertainer was sufficiently established to assure them of that. On behalf of the city of Montreal, he was pleased to tender to the Association an invitation to hold its next convention there, and speaking for himself and others, they would do everything they could to promote the success of the meeting.

The President remarked jocularly that he supposed it would hardly become necessary for the Christian Endeavor young men of Montreal to organize for the protection of the Association in the event of their paying a visit to Montreal.

Mr. Yule moved that the next convention of the Association be held at Niagara Falls.

Mr. Armstrong seconded the motion.

Mr. McFarlane said he was an active member of the Association, and a resident of Montreal, and he would be very glad to invite the Association to bring the convention there. He feared, however, that very few of the members would come down there. He thought the organization was hardly large enough yet. If he was sure there would be a good attendance he would be only too happy to have the meeting held in Montreal, but under the circumstances he thought it wiser to wait until the Association had more members.

Mr. Taylor thought the Association would gain strength by going to Montreal, that a great many additional members would be secured by a visit to that city. He was very much in favor of going there.

Mr. A. A. Wright was in favor of going to Montreal. That city had in connection with McGill College one of the finest, if not the finest, electrical department on the continent of America. He wished those who were at the head of affairs in Ontario could go there and see it, and be ashamed of themselves, and endeavor to do more than they were doing at present to advance electrical education. He admitted they had done a good deal, but he would like to see them doing more for this branch of industry, the greatest industry in the world he would say. In regard to the motion to hold the next meeting at Niagara Falls, they would be having a little meeting at that place to-morrow, and he thought that would have to be sufficient at the present time. He believed it would be in the best interests of the Association to hold the next meeting in Montreal.

Mr. Kammerer said that for members living in Ottawa, Renfrew and other eastern points, Montreal was more convenient than Toronto, and just as near for nearly all except those living west of Toronto. He thought some consideration was due to the Montreal people for the interest they had evinced in the Association, and even if it did cost a few dollars more he was sure all would be well repaid for the extra expenditure.

Mr. Merrill urged as a reason for not selecting Niagara Falls the fact that it would be two years before the plant there would be in running order, perhaps three years. The first turbine would be placed in position about February or March, but that was only the starting point, and it would he thought be better to wait until a later period than next year for holding a convention at the Falls.

Mr. Johnston thought it would be better to hold the meeting in Toronto. There were a great many electric light men who had not taken the active interest in the Association that they ought. The telegraph and telephone companies were very well represented. While it was no doubt true that the Montreal members had been very attentive at meetings, it must be remembered that the principal following of the Association came from this section, and for that reason, while he might otherwise be inclined to favor Niagara Falls, he thought it would be better to hold the next meeting in Toronto, and after that the Association might be in such a position as to take a large following to Montreal.

Mr. A. B. Smith suggested a plebiscite to see how many members would go to Montreal in the event of the meeting being held there next year.

Mr. Starr thought if the meeting was held in Montreal a great many Montreal people not now included would become members. Three conventions had now been held in the west, and he thought a meeting held in Montreal would result in the addition of more members than would be gained by one held in the west.

Mr. Thomson said there was a little Electric Club of 25 members in Montreal, who, if the meeting were held in that city he thought would join in a body. He thought the meeting ought to be held in Montreal next year, and after that at St. John, N. B., and the membership and influence of the Association would in that way be extended all over the Dominion.

The President then put the amendment—that the next convention be held at Niagara Falls. The amendment was lost.

The original motion, that the next convention of the Association be held in Montreal, being then put, was carried.

The following paper was then read by Mr. McFarlane :—

HISTORY OF THE TELEPHONE IN CANADA.

BY L. B. M‘FARLANE.

As the object of this Association is not only to foster the science of electricity but to conserve its records, I have ventured to deviate from the usual plan adopted by members in their papers, of dealing wholly with the scientific aspects of the subject, and offer instead a brief historical sketch of The Telephone in Canada—the country that can with truth be called the birthplace of the telephone.

Professor Alexander Graham Bell's home was, for several years prior to the invention of the telephone, at Tutello Heights on the outskirts of Brantford, Ontario, and it was there that many of his experiments in multiple telegraphy, and some of the earliest in telephony, were made.

The first experimental telephone line erected in Canada and used in this connection, extended from the residence of the inventor's father across his garden. This line being found workable, it was afterwards continued on to the residence of the Rev. Thomas Henderson, in Brantford. Its successful working soon became noised abroad, and the novelty of the invention attracted many visitors from various parts of Ontario to listen to the then wonderful performance of the electric telephone; and presently Brantford became known as the "Telephone City." At this time the much condemned "Hello" had not come into use as a signal for conversation to begin ; the words "Hoy Hoy" were considered most satisfactory. We must give a discriminating public the credit of choosing the less objectionable word, and be thankful that "Hoy Hoy" did not survive.

When the Canadian patent was issued to Prof. Bell, he presented it as a gift to his father, Prof. Melville Bell, and the latter, believing a company or partnership unnecessary, appointed a general agent to exploit the Bell Telephone. The latter visited the principal cities and towns and exhibited the old fashioned box telephone, with but little commercial success. however, as the difficulty of hearing the voice clearly rendered problematic its future value as a means of communication.

The first commercial telephone line was established at Hamilton, Ontario, in October, 1877, by the District Telegraph Company, who were quick to appreciate its value, and they therefore secured control of the invention for that district. This line connected together the residences of Messrs. Baker and Cory.

Mr. Edison at this time was not neglecting Canada as far as telephony was concerned. He had opened up correspondence early in 1877 with the City Electrician of Montreal, and forwarded two sets of his telephones for trial. These were placed on the telegraph line between Montreal and Quebec, a distance of two hundred miles, and worked with remarkable distinctness, notwithstanding the presence of several relays in the circuit.

On the 15th September, 1877, a contract was entered into between these gentlemen, whereby the latter secured the sole and exclusive right to the telephonic inventions in Canada of Mr. Edison for a nominal sum, with the option of purchasing outright the patents for the sum of $10,000.

The element of competition was thus introduced at the outset of the business. Both parties claimed priority of patents, and threatened suit against all and sundry users ; but while this rivalry continued until 1880, it was not known that Edison as early as 1877 had admitted Bell's claim to priority. This he did in a letter to his Canadian representative, under date of October 13th, 1877, wherein Mr. Edison stated that :

"Bell has done absolutely nothing new over Reiss, except to turn Reiss' from a contact breaking into a non-contact breaking telephone with permanent magnet, and worked the thing up to a success. The records of the patent office will show that myself (Edison), Bell and Gray started nearly together on acoustic telegraphy for Morse working, that Bell and myself dropped this for speaking accustic and that I dropped it first and was working on it before Bell. However, Bell got ahead of me by striking a principle of easy application, whereas I have been plodding along on the correct principle, but harder of application."

The cry of infringement failed to deter lessees from using the telephones, and numbers of private lines were erected in Montreal and Toronto. These lines formed the nucleus of exchanges in these cities, which were first put into operation in 1878.

Montreal was equipped with the Edison apparatus, while the local company operating at Toronto adopted the Bell instruments. The Blake and Edison transmitters having been introduced, the business began to show some development.

The Western Union Telegraph Company, through its ally the Gold and Stock Telegraph Company, secured in 1878 control of the Edison patents for Canada, and the Montreal Telegraph Company were appointed agents for Ontario and Quebec, and the agents of the Western Union Telegraph Company in the Maritime Provinces were ordered to look after the telephone in the lower Provinces. In telegraphic circles it was thought that whoever could control the telephone, could command the bulk of the telegraph business, and the telephone was used principally as a lever to this end. The Dominion Telegraph Company, then in fierce competition with the Montreal Telegraph Company, became alarmed at the apparently shrewd move on the part of its rivals, and immediately set about securing exclusive rights of the Bell telephone as a weapon of defence. Negotiations resulted in a contract between the patentee and the Dominion Telegraph Company, and the three telegraph companies started in a race to secure subscribers to their Exchanges in the cities and towns from Windsor to Halifax, where Exchanges inaugurated by local companies did not already exist. Some cities were, however, slow to appreciate the use of the telephone, notably Ottawa and St. John, N. B. At Ottawa an active canvass was commenced, but in order to save time a complete telephone exchange outfit was shipped there ; the canvass was unsuccessful ; no subscribers were forthcoming, and the plant had to be stored until the public could be educated into the use of the telephone. At St. John only one subscriber could be secured after two weeks canvassing. A brilliant idea then occurred to the manager of the opposing company at this point and was carried to a successful issue. It was to open a free Telephone Exchange, on trial. This at once demonstrated the necessity for an Exchange, and soon two competing Exchanges were working, and unable to keep pace with the paying orders offered.

This struggle between the Telegraph Companies, which signally failed in its main object of diverting telegrams to any one company, resulted not alone in cutting telephone rates to absurdly low figures, but in doing business absolutely without charge. To such competition there could be but one end, and it was soon reached. There had been a large capital outlay, and the revenue did not by any means meet the expenses. A proposition at this time to form a separate Telephone Company, independent of all Telegraph Companies, was made by Mr. Charles F. Sise, the present Chairman of the Bell Telephone Company of Canada, and Mr. Hugh C. Baker, Manager of the District Telegraph Company of Hamilton. The suggestion of these gentlemen was gladly accepted by the interested companies and patentees, and by the public at large, who were suffering in most cities from the annoyance of two Telephone Exchanges. The Bell Telephone Company was thereupon organised and incorporated in 1880, when it took over all the existing plants and patents, reorganized and consolidated the Exchanges, and began the manufacture of all kinds of telephonic apparatus.

The work of constructing lines connecting adjoining places was begun on the single wire plan, and towns and villages within a radius of one hundred miles were given direct means of telephonic communication. This added to the value of the Exchanges, and as the business prospered, a question was raised by interested parties, anxious to embark in the business, as to the validity of the Bell patent. Two telephone companies were formed by these parties, and local competition at a few points ensued. The patent dispute was brought before the Minister of Agriculture at Ottawa, and as you all know the patent was lost to the Bell Telephone Company in 1885. A similar fate befell the Blake Transmitter Patent, and as the Minister's decision was final and irrevocable, the telephone field was opened to all comers. Notwithstanding this blow, the Bell Telephone Company continued to rapidly increase its list of subscribers and revenue, and their competitors were left to the tender mercies of their creditors, who found the venture, while it succeeded in breaking the patents, had proved an unprofitable financial undertaking. Later on competition appeared in several localities, but as the connections of these opposing concerns were necessarily limited, they again demonstrated the inutility of working a duplicate telephone system in a city or town, by disappearing from the scene without even having paid a dividend.

A local company was formed in Nova Scotia and New Brunswick and after a short struggle with the Bell Telephone Company an agreement was arrived at whereby each of these Provinces would have a separate telephone company, the Bell Telephone Company withdrawing from the field, but retaining an interest in each company. These companies have covered their territories with Trunk Lines and Exchanges.

The local company of Prince Edward Island, which had previously been formed by the Bell Telephone Company, has, however, reached the highest stage of expansion, it having a net work of wires which reaches every town and village on the Island.

The Bell Telephone Company were early in the field in Manitoba and the North West, and have kept pace with the development of this territory, by opening stations at all points where business would warrant.

British Columbia is served by local companies, using the same type of instrument as Eastern Canada. These companies have been most energetic and progressive in their policy. As an indication of this we can note the fact that Vancouver, B. C., was the first Exchange in Canada to alter its entire system at great cost, and give each subscriber a separate metallic circuit line.

Canada has kept pace with all the advances in the art of telephony. Metallic Trunk Lines between towns in Ontario and Quebec were erected and put in operation when the system was first introduced into the United States, and all the best and most modern switching and signalling appliances have been furnished, thus ensuring to the public a most reliable service. On some points it may be said that Canada is in advance of other countries ; notably in the use of the system of Duplexing Telephone Trunk Lines, which is now in operation in Toronto.

The vast number of country Trunk Lines, both metallic and single in the older Provinces, show that the service is appreciated and used by all classes of the community.

In a brief paper of this nature many interesting and instructive facts must necessarily be omitted ; those that have been touched upon will not only show the rise and progress of the telephone industry in Canada, but should prove that we are in the van in this branch of electricity.

After reading the paper Mr. McFarlane said that a great deal of it had been written from memory, but that after he sent the manuscript to the Secretary he had had the pleasure of meeting Professot Bell in Montreal, and had questioned him on some of the points dealt with in the paper, and had been told that as a matter of fact he and his uncle, Professor David Bell, worked the first telephone line between Brantford and Paris, that is the first practical telephone working any distance. At that time they did not know how they could work long distance lines, and Prof. Bell went up to Paris and borrowed the lines of the Dominion Telegraph Company, taking with him a few large resistance coils, and by inserting these he found what would make a workable telephone. He said that was practically the first workable telephone line they had. It was a private test—not made publicly, and it was quite successful, although the battery was at Toronto, some sixty or seventy miles away.

Mr. Dunstan said he thought the thanks of the Association were due to Mr. McFarlane for the paper just read, which, valuable as it was now, would become more so as a record of facts in connection with the invention of the telephone.

Mr. Thomson asked in what year the experiments were made.

Mr. McFarlane stated it was in September, 1875, when Prof. Bell's home was at Brantford.

Mr. Thomson said he believed Prof. Bell gave his first public exhibition of the Telephone in the United States in September, 1876, in Philadelphia during the Centennial.

Mr. Kammerer seconded the motion for a vote of thanks to Mr. McFarlane, which was then put to the meeting and carried.

The following paper was then read by Mr. E. B. Merrill :

THE EDUCATION OF THE ELECTRICAL ENGINEER.

BY E. B. MERRILL.

Though the subject of the education of the electrical engineer has received considerable attention from electrical societies, and in the electrical press of other countries, it has not so far been discussed in our own society ; so that in view of its importance to the rising profession it may not be fruitless of good results to those of us interested in the education either of ourselves or of others, if we spend a short time in considering it here.

Like everything else electrical, the scope and methods of electrical education are continually changing, and on the whole in the direction of improvement. In no profession are the instructors so closely connected with the practice, and to this vital contact they owe a great deal of their strength. This helps to keep them abreast of all advancements and greatly increases their value to the student engineer.

In the widest sense of our subject we should have to do with more than a college education. That is only one phase of it. It neither begins nor ends here. There must be a preparation, and afterwards there must be a continuous advance if one is to retain or better his position. We must not get the idea that a graduate is an electrical *engineer*, though he may have earned the distinction of such a degree. He is in reality merely in a position to make a start, but if he has faithfully cleared up the work behind him he is able to make a good start and a rapid advancement. A college training is necessarily one-sided and needs the addition of practical experience to complete it.

However, let us limit ourselves to the consideration of the college education. And first, is it necessary? and if so, what should be its aims and in consequence its important features? Is a college education or an equivalent an essential part of the equipment of the electrical engineer?—we say an equivalent, for it is quite possible, though generally attended with great difficulty, for a man to follow out a course for himself by making use of spare minutes and taking advantage of every opportunity. But the instances of those that have accomplished this satisfactorily are not many.

A few years ago the answer to this question would perhaps generally have been different from what it must be to-day. We have little hesitation now in answering it in the affirmative. An adequate training in mathematics and electrical and mechanical principles must be had, however it is obtained. The college course itself is not all important but it offers great advantages. Besides the guidance and help of the instructors, the fact of the time being carefully mapped out for employment, and the familiarity gained with the use of apparatus and machinery not often accessible elsewhere, the student has also the assistance derived from association with others and the encouragement of emulation between those working along the same lines: factors whose importance is not often overestimated. It is true that a good man, by himself, may do more than a poor man at college; but the same man will do much better with the assistance to be derived at college. A college training will not always make a good man out of a poor one, but it will make a better man out of a good one.

Of course we cannot overlook the many examples of men who have done well, and some who have met with great success, who have never entered college or taken up advanced mathematical and scientific work; but if you were to question these, you would find that most of them regret that they did not see the value of such an education sooner, or that they have not had the opportunity or time to avail themselves of it. It is a sufficient indication of its value to glance over the foremost names in the electrical field and to note the proportion of them that have received this training. That it is being appreciated is shown in the demand of the large companies for graduates of engineering schools, some admitting none but such men to the special student courses established by these works for the purpose of training men to look after the installation and running of the machinery they manufacture.

There are still some, however, who advocate the merits of the machine shop, the repair shop, the dynamo and motor room, field and armature construction and winding, the test room, &c., as an ample schooling, but the weight of opinion is now that the electrical *engineer* needs something more. A man who is trained only in this way and has not obtained a pretty good working acquaintance with the elementary laws of electricity and magnetism, is liable to make ridiculous if not serious mistakes, which the man properly grounded in these principles could not possibly fall into. As a case in point it came within our notice not so long since, where three men trained in this way agreed that a certain connection of the shunt fields of an Edison dynamo was wrong and had it changed because they had not seen it made in that way before, and although it was pointed out to them that the current had to circulate in exactly the same direction in the coils as it did with the connections with which they were satisfied.

And what are the essential elements of this college education? This brings us to another important question. It is that of—*specialist or generalist?* or, to what extent should one specialize?

Is the electrical engineer to be a mechanical engineer as well? Some have answered "yes," and others more recently have said "no," with considerable emphasis. Sir Wm. Thomson, now Lord Kelvin, gave as his opinion that the electrical engineer should be nine-tenths mechanical and one-tenth electrical; some of the best educationists across the line would now reverse these figures. Perhaps both are extremes; at least they appear to be so for the requirements of the average electrical engineer of the present and for some time to come. Conditions have somewhat changed since Sir Wm. Thomson gave this advice, although there are still some engineers not even one-tenth electrical. A more even division would, however, better meet the present requirements.

The man who is working along advanced lines has need for economy. The electrical field is now so wide and extending so rapidly that many may well occupy all their time on special work. Such men are able to do with only a slight acquaintance with mechanical engineering. However, the general electrical engineer is not a specialist. As the general practitioner in medicine, he must cover a wider field. In installing plants for lighting, power supply, &c., he has to do with steam engines and boilers and all their accessories, with shafting and bearings, belting and gearing, fly wheels, driving pulleys, &c., with water turbines and their control, with the fitting and running of construction and repair shops, &c., &c. He should therefore be familiar with at least the mechanical principles of the construction and running of ordinary machinery, the running conditions of the steam engine and the utilization of water power. It is not necessary that he should be a practical machinist. Most engineering colleges, therefore, either combine the two courses, or else require the electrical student to cover a good deal of the work in mechanical principles. A large part, such as the mathematics and mechanics, is necessarily the same in both.

In the planning of a college course, one of the first difficulties met with, is in deciding the relative importance, with regard to the time-table, of the theoretical and practical work; and this is what different colleges disagree upon most, some devoting considerable time to foundry work and pattern making, forging, machine shop work, such as vise work, turning, &c.; while others restrict the practical work to draughting, electrical testing, engine and boiler testing, dynamo and motor testing, &c., which involve the application of the more difficult principles and assist to illustrate and impress them. We think it a safe rule to follow in college to sacrifice practical work to theoretical when the former involves chiefly those operations which one can pick up readily in practice, or the mere acquiring of skill in a mechanical operation. In engineering, and especially in electrical engineering, the mathematical and scientific training necessary is becoming wider and wider. Once an engineer has started out in practice he has little time and usually less inclination to go back and work up mathematics. If he has not had a good mathematical training he finds himself unable to read and to keep abreast of the greater part of the electrical literature in the periodicals. He is not *up to date* in electrical matters, probably becomes disgusted with advanced electrical work, and the plums of the profession, the introduction of new applications, the perfecting of methods, designing and inventing, he resigns to others. With the man, however, who has devoted three or four years to a careful study of mathematics and the direct and related principles underlying the science of electricity it is different, for though he still may have some difficulty in following electrical advancement he is not wholly at sea. It is best therefore that the college student should pay special attention to those parts of his work that are usually classed under the head of theory. It is true that he may not do as well at first when he starts out in his profession as the graduate of a school where more attention is given to the practical side, but he will more than make it up in the long run. It is a case of slow but sure.

Another objection to the class of practical work before mentioned—foundry, machine shop work, &c., is that, in college, it is usually under too artificial conditions, and is therefore not of as much value to the engineer as if he had obtained the experience in actual machine shops, &c., under normal conditions, and especially is this true in questions of the commercial value of the work done. Moreover, students may obtain this practical experience, or a large part of it, before graduating, for in most colleges there is a long summer vacation; in our own in this city they have five months, and the students are especially advised to, and most of them do, obtain employment in various works, mechanical and electrical, and so supplement their course in a valuable way. An electrical student should, if possible, obtain his experience in an electrical machine shop for construction or repairs—the more general the work the better—and in this way he will be obtaining mechanical and electrical practice at the same time.

We have not the time now to go with more detail into the work of the college, or consider what subjects should or should not be included in the course and how they should be dealt with. The importance of the laboratory as an educational aid is generally recognized; a good library is also a great help, and in our day of such rapid advancement the electrical journal is indispensable; but a wide-awake staff and students that *mean business* are the chief factors in the success of any college.

A member suggested that Mr. Nicholls, owing to his position and experience, should be able to make some remarks on the subject of Mr. Merrill's paper, which could not fail to be instructive.

Mr. Nicholls said if the gentleman would indicate on what line he desired him to speak he would have pleasure in doing so. The paper just read by Mr. Merrill was a most able treatise on the subject, and while on his feet he would propose that a vote of thanks be given him for preparing and reading it. Mr. Merrill had evidently considered the matter from the point of view of the student or University graduate. He could quite understand, indeed he had met with the same difficulties in his own business, that a student after having spent a long time at college in a scientific course, felt considerably at sea on going into employment at such an office as the one of which he was manager. They had received a valuable theoretical training, but they were completely at a loss until they had received that practical training which alone would enable them to fill the office of superintendent or to guide the progress of an electrical enterprise. He noticed Prof. Rosebrugh in the room, and he thought it would be interesting to hear from him as to the full extent to which the electrical course was carried in the School of Practical Science. In the company with which he himself was connected they had a student course, lasting from eighteen months to two years, during which time the student passed through every department of electrical industry, and not only in the machine shop, but in practical operation and construction on the road, because they had to spend at least three months on outside construction; and by the time they were through with that course they generally were capable young fellows. If they had had previous training in the School of Practical Science, the University, or some other technical college,—and he thought we had as good facilities of that kind here as any in the United States—the practical course was very much simplified, because they commenced with an understanding of the principles, and it was well known that where the principles are not understood of any mechanical piece of work it is much harder to gain a proper appreciation of the undertaking.

Mr. Black said that the paper was one to which he had looked forward with a great deal of interest, and the subject was one which he thought would engage a very large share of attention on the part of members of the Association. Some three or four years ago, he had begun the collection of the calendars of the different technical colleges which engaged in teaching electrical engineering, and he had been very much struck by the difference between the various courses, no two of which exactly agreed; in fact some were very wide apart, and no two agreed upon the necessary qualifications for entering the college. There were great differences in the workshops and apparatus possessed by the different colleges. In some a fair knowledge could be obtained of the rules and working apparatus connected with engineering; others were unhappily deficient and had no apparatus whatever, nothing even of a repair shop. Our own School of Practical Science had adopted a middle course; it supplied considerable apparatus for testing purposes, but there was no machine shop. It was thus a very difficult matter to decide from the calendars which college to attend. The courses after entering were also very wide apart. The essay stated that Lord Kelvin had laid down the rule that the electrical engineer should be nine tenths mechanic and one tenth electrician. Some reversed this, and held that he should be eight tenths electrical and two tenths mechanical. Cornell University might be taken as an example of the colleges in which they gave, or profess to give, a thorough drilling in the use of tools and machinery. They had a plant there which cost millions of money, driven by hundreds of horse power and they had a 600 horse power wate wheel, as well as steam. Lehigh had nothing in the way of ma chinery at all, but had arrangements with certain shops by which the students could go in and see the work. They professed to give them sufficient manual training by a foreman or superintendent. He observed by reading electrical papers that the professors in the leading electrical colleges of the United States were not agreed as to the necessary training, some recommending one course, some another. The University of Wisconsin, where they attempted to specialize, had three or four different courses, and advised students to take a special course. Some of the courses, as railroading, were more mechanical, others more purely theoretical in connection with the telegraph and telephone. He thought the discussion of these papers at the conventions, and the consideration of them by members between the conventions, was very useful to the profession at large. No doubt in the course of time a more uniform system would be arrived at. Here in Canada we had two special schools for such training, one at McGill College, where they had recently adopted a mechanical or workshop course, and one in the City of Toronto, where they gave theoretical training and provided testing machinery, etc. Members of the Association who wished to send their young friends to these institutions would have to study the two systems up and choose between them.

Mr. Galt said he had no doubt in his mind that the question of educating electrical engineers should be from the theoretical standpoint followed in the colleges. There was danger in introducing into the college work manual or machine work, except as an auxiliary in connection with final testing work. He doubted the desirability of colleges taking up this practical branch, and held that it was wrong to inculcate the idea that young students were able to gain at colleges both a theoretical and practical knowledge. The tendency of the present age was to specialize as much as possible, and he thought one who desires to become proficient as an electrical engineer should not devote two years to acquiring a smattering of mechanical engineering or any other branch of engineering. In cases where he desires to avoid blunders the electrical engineer should rely on some expert mechanical engineer if it was a matter of a mechanical character that was being dealt with. He thought that course would be much better for all parties. He was not inclined to agree with Lord Kelvin's dictum, that the electrical engineer should be nine tenths mechanical and one tenth electrical. He believed that the electrical engineer must be largely electrical, having sufficient mechanical knowledge to enable him to appreciate the necessity of seeking expert help to keep him out of trouble in that branch. Much attention had been paid by educationist to this line, and there was no reason to complain of the facilities afforded in this line in Canada, there being two large establishments, that in connection with McGill, and the Toronto School of Practical Science, as well as minor institutions. In these a first rate theoretical training might be had, and he thought the correct idea was for the students to go out from these places and acquire practical knowledge in the way Mr. Nicholls had spoken of, in work shops connected with general electric work, in which way they would become thoroughly efficient.

Mr. A. A. Wright asked.—"What do you send your boy to college for anyway, what are you going to do with him? You send him there so that he may earn a living. The question is, when he comes out of college, what is he going to do." A man who lived in England wanted one kind of an education, and a man here in Canada another kind. A man who went to Oxford went to be a specialist, a mathematician, a modern language man or something else. Here in Ontario it was necessary to know a great deal about everything. At one time when a man took charge of a high school he had to be acquainted with mathematics, Latin, Greek and foreign languages, but that was changed now. One master taught modern languages and another classics, and so on, and he believed a time was coming when there would be nothing but specialists. But at the present time it was necessary for a man to know a great deal about everything. He needed to be able to go into an electric light station and take charge of and handle the plant and run a dynamo, and to know a good deal about everything. It seemed to him that a man who attended college ought to know a great deal about everything; he believed that when a young man went to one of our colleges and took up practical work he ought to know a great deal when he got through. He thought the proper course was to send a young man to the high school until he knew a great deal about mathematics, because he could not get along in electrical studies without that knowledge. Then he should learn French, because it would be of great service to him by enabling him to read electrical literature published in France, which was a great electrical country. Then he would have him go to work and run a dynamo and look after the plant, and it would not take him long to acquire a knowledge of the work. Then he believed he should take up this course; this three years course should be identical with a mechanical and electrical course. The fourth year he could take up either electrical or mechanical engineering as was preferred. During vacations he could do as was suggested in the paper read, get into some workshop where he could see the kind of work he was going to be engaged at, and in that way become a real practical man, and that was the kind of men wanted, men who were not afraid to tackle practical work. The sooner our young men knew they had to work the better for them. He wished to second the motion for the vote of thanks to the writer of the paper read, because it was a really valuable one, and too much credit could not be given to the gentlemen who prepared these papers for the benefit of their fellow members of the Association.

Mr. Johnson said that by the time a young man had passed through a scientific course he was perhaps a little too old to take hold of shop work. He thought that as had been suggested, they should take advantage of their vacation to acquire a knowledge of practical work, which would be of the greatest advantage to them. He considered the practical part absolutely necessary. There were occasions when an electrical engineer might be called upon to fix some part of an engine or dynamo in a town where he would not be able to secure the services of a good machinist. He thought, therefore, that after a young man had obtained a high school education in mathematics, he ought if possible to take a machine shop course of practical training, and after that a year or two spent in higher theoretical training would be of advantage to him, or even before taking the machine shop course he could take the course of the School of Practical Science, then the machine shop, and then one or two years in the best college he could find.

Mr. Breithaupt thought the machine shop training should be obtained very largely outside of the college, that the theoretical course should be distinct from the machine shop training.

Mr. Rosebrugh said the members might be interested in hearing what was the course at the School of Practical Science, in Toronto. The work in the mechanical engineering course was much the same as in the purely mechanical course for three years, and in addition to this, running through the entire course, starting at the very first term, was a course of electricity, which ran in this way. In the first year was a course at the University by Prof. Loudon, on electricity and magnetism, taking a rapid run through the whole range, giving the student who had never considered the question a good general idea on the subject, probably as much as any ordinarily educated person who had made no special study of it could be expected to know. Immediately following this was a course in the School of Science on the flow of electrical current. Following that in the second year, a course was given in electrical measurement of currents and resistance. Then the third year the subject of dynamos and motors and storage batteries was considered, the continuous current only, alternating currents being left to the fourth or post graduate year, on account of the extra mathematical difficulty involved. In the fourth year, which was not taken up by all the students, nearly the entire time was spent in laobratory work. With regard to the machine shop work, that was entirely outside of the four years work of the school. In order to obtain the diploma of the school it was necessary to present a certificate of having had one years practice, so altogether it involved a complete course of five years.

Mr. F. Thomson said the question had often been asked in Canada whether an electrical engineer was required to run these electric plants. He thought the average pay of electrical engineers running plants would be about ten dollars per week. There were in the Province of Quebec quite a number of colleges that professed to turn out electrical and mechanical engineers. Many of these institutions possessed only the most rudimentary and antiquated appliances, and the professor who instructed the student knew practically nothing of what he was talking about. A number of graduates of the schools had presented themselves to him seeking positions, with a certificate stating they were thoroughly qualified to take hold of almost any electrical plant. The question seemed to him to be, would the use of electricity develop to such an extent as to make room for all those who were crowding into the business. The large firms were combining, and many of them had at their head half a dozen electrical engineers well versed in the business, and these firms had no room for students. These latter were obliged to take some very minor position at a small salary, and many of them eventually left the electrical business and entered into some other pursuit. It was his experience of what became of the electrical engineers trained in some of the colleges that there was no work for them to do.

Mr. Langton said on the point referred to in the paper regarding students spending the summer vacation in machine shops, he did not see how they were going to do that. In most shops the apprentice was regarded somewhat in the light of a nuisance for the first six months or a year, and he did not think any great alacrity would be shown on the part of machine shops to take in a boy for five months and then let him go. Undoubtedly it would be the best way to combine theoretical and practical work, but great difficulty existed in carrying out that arrangement. He fully agreed with all that had been said regarding the necessity of practical work. A certain degree of this practical knowledge could be imparted at the colleges. For instance, the foundry branch taken at college was very useful; though the student worked at moulding impossible forms which he would never mould in practice, he learned what to avoid. But the attempt to produce actual machines in the machine shop at college was certainly a very great waste of the student's time. He quite agreed with Mr. Thomson that many of the young men now making their way into the electrical profession would be disappointed, because they were paying too much attention to the electrical part rather than the engineering part of their training. Any extensive development could only be looked for in the field of commercial adaptation of electricity. He did not quite agree with the definition of Lord Kelvin, but in commercial electrical work, in engineering and railway work, a man required to be as much, if not more, a civil or mechanical engineer as an electrician.

The President said he had frequently wondered what was going to become of the large number of electrical engineers manufactured, but he supposed that, as in the case of the lawyers and doctors, it would be a case of the survival of the fittest.

Mr. Nicholls said he hardly thought so. To be a lawyer or a doctor, although there were no doubt numerous aspirants, one had at least to have a certificate of competency, and they were obliged to serve a proper term and pass a rigid examination before being allowed to assume the duties of those professions. In the electrical business the term of electrical engineer as applied to Canada was a misnomer, for they were very few and far between.

Mr. Langton said he had forgotten one point he intended to have mentioned, that was that in Canadian establishments a better opportunity was afforded of studying the practical work in detail than in the larger concerns such as that at Lynn, Mass. In these latter the student was moved about and saw various operations, but not very much personal attention was given to him, and he only saw one thing at a time, whereas in Canada, in such a shop as that of the Canadian General Electric Company at Peterborough, he saw all varieties of work, and that on a smaller scale, and came into more immediate contact with the various difficulties and points arising. He therefore thought that Canada offered a better field for education in electrical engineering than the United States did.

The President then put the motion for a vote of thanks to Mr. Merrill for his paper, which was carried.

The President then said that, as there were a few minutes to spare before the time for adjournment, and as he understood that Mr. Thomson had been experimenting to a certain extent with alternating currents of high tension, he would ask that gentleman to give a few remarks on the result of his experiments, and as to the possibility of getting up an alternating current of sufficiently high tension to use in the way proposed by the parties who were exploiting these large power works, and also as to the possibilities of constructing a dynamo that would stand tension of such a character.

Mr. Thomson replied that he could not say much as to how the experiments referred to would turn out. He had intended to prepare a paper on the subject, but had not been able to do so for want of time.

The meeting adjourned for lunch from 12:30 to 1:30.

AFTERNOON SESSION.

The Convention was called to order by the President at 2 p.m.

Some discussion took place as to the time at which the next meeting should be held, and it was decided to leave the matter in the hands of the Executive Committee to nominate a date about the end of August or the beginning of September.

ELECTION OF OFFICERS.

Mr. Kammerer inquired if the nomination of officers was now in order.

The President having replied in the affirmative :—

Mr. Kammerer nominated the present President, first and second Vice-Presidents to fill the same offices next year. These gentlemen had made a success of every meeting thus far, and as there was a little doubt as to whether next year's meeting was going to be a success or not at Montreal, he thought it would be well to retain their services.

Mr. Nicholls seconded the motion.

Mr. A. A. Wright thought this method of nominating *en bloc* was not a regular mode of procedure.

The President said the fact of the nomination being made in that way did not necessarily imply that they would not be balloted for separately.

After some further discussion, no further nominations being made, the three officers nominated by Mr. Kammerer were declared elected to the same offices for the forthcoming year.

The President then said that the course taken was one not at all anticipated by him, and he would have preferred that some one else had been elected President. He had always done all that lay in his power to advance the interests of the Association from its commencement to the present time, and it did seem to him that it would have been better that some one else should now relieve him of the duties of the office. However, as it seemed to be the wish of the Convention, he had no alternative but to fall into line. The success of the Association was what he desired to see, and he could be relied on to do everything in his power to further its interests.

Vice-President Dunstan said in view of the fact that the next Convention was to take place in Montreal he felt rather strongly that the officers should have been of that city. If the Convention thought otherwise, however, he bowed to their wishes, and would do all he could to make the Montreal meeting as great a success as possible.

Vice-President Carroll also spoke briefly, stating his intention to do everything possible to insure the success of the meeting at Montreal.

Mr. C. H. Mortimer was then nominated for Secretary-Treasurer by Mr. A. B. Smith, and no other nominations being made, was declared elected.

Mr. Mortimer suitably acknowledged the honor conferred by his unanimous re-election, and assured the members present that in the future as in the past, he would bend all his energies to secure the success of the Association.

The President then stated that there were ten members of the Executive Committee to be elected. According to the amendment made to the Constitution, five of these would hold office for one year and five for two years. It was thought as well by several members that the members should be elected at the present Convention, and the question as to which five shall continue in office be determined at the next election. If that is the pleasure of the Convention it could be so ordered.

Mr. Nicholls asked how that would be determined at the next meeting.

The President explained that the first five members of the Executive Committee would be elected for a second year, and then five more would be elected to fill vacancies.

The nominations were then received as follows :

Mr. Dunstan nominated Mr. A. B. Smith, of Toronto.

Mr. Nicholls nominated Mr. John Yule, of Guelph.

Mr. Yule asked to have his name withdrawn.

Mr. Nicholls said a nominee could not withdraw without the consent of his nominator, and he declined to consent to the withdrawal of Mr. Yule's name.

Mr. John Carroll then made the following nominations : Hamilton, Mr. D. Thomson and Mr. Geo. Black ; Toronto, Mr. A. B. Smith and Mr. J. A. Kammerer ; Ottawa, Mr. T. Ahearn ; Peterboro', Mr. J. W. Taylor ; Montreal, Mr. L. B. McFarlane and Mr. D. A. Starr ; Owen Sound, Mr. S. J. Parker ; Guelph, Mr. John Yule.

Mr. A. A. Wright expressed his surprise at this wholesale nomination. It seemed to him a very strange method of procedure.

Mr. Nicholls then nominated Mr. A. A. Wright, of Renfrew.

Mr. Wright said he had more business than he could attend to, and although Mr. Nicholls had raised the point that Mr. Yule could not withraw without the consent of his nominator, it took two to make a bargain, and he must positively decline the nomination.

Mr. Yule nominated Mr. Rosebrugh, of Toronto.

Mr. Taylor, of Peterboro', asked to withdraw his name, and to nominate Mr. Fisk, of the same place.

Mr. Nicholls nominated Mr. C. P. Dwight and Mr. K. J. Dunstan.

Mr. Dunstan nominated Mr. Fred. Nicholls, of Toronto.

Mr. Nicholls said that as a matter of principle he would prefer that his name should be withdrawn. Much as he appreciated the honor, he did not think that a man interested from a business stand-point in dealing with a large class of active members in such an Association as this should accept an office in it. Since its inception he had done all he could to help forward the work of the Association and would continue to do so. But if the Association was to be successful it should be managed entirely by active electric light, telegraph and telephone men, and not by any one who had axes to grind. He had taken that position from the first, and he felt just as strongly as ever on that point to-day. He was happy to be present at the meetings of the Association as an active private member, but at that point he thought his interest in it should cease.

Mr. A. B. Smith nominated Mr. John Galt.

Mr. Carroll nominated Mr. John Langton.

Mr. Langton said he thoroughly agreed with the views just enunciated by Mr. Nicholls—that officers of the Association should be buyers and not sellers. He must therefore decline the nomination.

The nominations were then closed.

The President and Mr. Carroll were appointed to act as scrutineers, and proceeded to take the ballot.

The ballot resulted in the election of the following gentlemen to compose the Executive Committee : A. B. Smith, T. R. Rosebrugh, Toronto ; S. B. McFarlane, D. A. Starr, Montreal ; John Yule, Guelph ; D. Thomson, Geo. Black, Hamilton ; E. Carl Breithaupt, Berlin ; H. O. Fisk, Peterboro' ; Thos. Ahearn, Ottawa.

Mr. Nicholls moved, seconded by Mr. Thomson, "that the thanks of this Association be tendered to the Industrial Exhibition Association for the use of the Directors' room and other courtesies extended to it, and that a copy of this resolution be forwarded to the Industrial Exhibition Association."

On motion of Mr. A. B. Smith, seconded by Mr. Taylor, the sum of $25 was voted to the Secretary-Treasurer for his services during the past year.

The following paper was read by Mr. Langton :—

DIRECT CONNECTED DYNAMOS WITH STEAM ENGINES.

BY JOHN LANGTON.

Dynamos directly connected to steam engines have been not uncommonly used in Europe from the first introduction of electric lighting ; so much so that the custom has been noted as a distinguishing characteristic of European practice compared with the almost exclusive use of belt driven machines in America.

The early direct connected dynamos were, however, generally uneconomical in material and were in fact high speed dynamos run below their most efficient speed, with a corresponding reduction of output in proportion to their cost. The advances made in the design of multipolar dynamos brought the efficient speeds of this type down to the point where the revolutions per minute compared with the speeds that can be efficiently obtained by modern steam engines, and so made direct connection a general commercial question. The credit for this is very largely due to German engineers and builders, who at the time of the Paris Exhibition in 1889 had brought the type to a high degree of perfection, and had built direct connected dynamos as large as 300 K. W. The general introduction of similar machines into the United States dates from the Paris Exhibition, and since then the rapid increase in their use has been a marked feature in the history of electrical progress on this side of the Atlantic. And although the principal use of machines of this class has been in large sized units, suitable only for large power and lighting stations, the practice has been gradually extended to machines of small power. Under these circumstances the subject would seem a fitting one for consideration by the Canadian Electrical Association, and the object of this paper is to bring the matter before the Association by briefly attempting to discuss in what manner the essential peculiarities of direct connection as compared with belt connection, affect the main items which go to make up the cost of producing electrical energy.

The high speed automatic steam engines which are now generally used, belted to dynamos without intermediate shafting, are all suited to direct connection. They thus afford means for an immediate comparison between direct and belt connection which will apply to the majority of cases, and which is divested of all considerations of steam economy by the use of identical engines in both cases. Any conclusions drawn from this comparison, to which the present paper is devoted, may then be taken into account in conjunction with the totally distinct question of steam economy with different types of engines. This is so, even for the case of slow speed engines, which in general are not suited to direct connection. The cost of production with high speed belt connected engines may be compared on the one hand with high speed direct driving engines, and on the other with slow speed engines, belt driving through intermediate shafting. The question of steam economy has been recently exhaustively treated in a most valuable paper on "The Cost of Steam Power Produced with Engines of Different Types," read before the American Institute of Electrical Engineers by no less an authority on steam engineering than Dr. Charles E. Emery, whose paper gives the items of cost analyzed and tabulated so that special corrections for special cases may be readily applied. (Dr. Emery's paper was republished in the *Canadian Electrical News* of May and June, 1893.)

The subject for present consideration is then narrowed down to the general cases of identical or equally good dynamos, in the one case belt connected and in the other direct connected, to identical or equally good steam engines, used in plants which do not present any special conditions of location or operation. The items of cost to be looked at are:

In the first cost of plant:

Cost of generating machinery complete ready for operation.
Cost of real estate and building to contain generating machinery.

In the operating cost of plant:

Repairs and small supplies.
Attendance.
Fuel.

Notwithstanding some saving in labor and material due to the use of a combined bed plate, the saving of two pulleys, of the whole cost of the belts, and (in situations where they would otherwise be used) of dynamo foundations; it does not seem probable that the first cost of direct connected dynamos and engines erected ready for operation will ever be less than or even as low as belt connected combinations. Any saving of material will be fully counterbalanced by the increased cost of testing the combined machines, whether the engine be brought to the electrical works for this purpose or whether the combined test be made where the plant is erected. Boilers, engines, steam-piping, pumps, condensers, and electrical apparatus outside the dynamo itself, are all unaffected; but for the dynamo connected to the engine the advantage in first cost is at present with the belt connected machine, an advantage it will probably continue to retain.

The principal difference between the two classes affecting first cost is in the engine room space required. This is most marked, and is in all its bearings the most important characteristic of direct connection. Dynamos belted to engines on the same floor occupy from two to three times the floor space of direct connected combinations, giving the latter a considerable advantage in the first cost of land and buildings required. Where the engines are on the ground floor belted to dynamos on the floor above, the total floor space is about twice that required for direct connection. In this case the real estate covered is the same for both, but the building cost is increased, not only by the extra cost of the second story, but also by the much more substantial character of the work necessary to support the weight and prevent injurious vibration. The double story arrangement of station also presents special difficulties of its own with the belts and bearings, even where dynamos not larger than 100 horse power are used. Where the individual machines are of comparatively small power, as in an arc lighting station, the double story arrangement seems to give satisfaction. By completely separating the engines from the dynamos it also probably somewhat increases the cost of attendance. In every case the saving in first cost of land and buildings has a definite assignable value and can always be taken accurately into account to determine whether it is worth saving. It becomes a matter of fact and not a matter of opinion—a fortunate circumstance in an item which presents greater variations in value than any other single one of those which must be taken into account, varying between such extreme cases as the business portions of New York, where the annual rental of floor space is $5 per square foot, and the small country town, where building lots can be bought outright for 5 cents a square foot.

It is surprising what can be done by direct connection in the way of concentrating power. In one plant the writer examined, 20 feet in length of an engine-room 18 feet wide and 8 feet high, contained four 75 horse-power engines direct connected to four 50 K. W. dynamos and the switch board for the whole plant, leaving comfortable room for the attendant to move about the machines and to get at and remove any part of them.

Turning next to operating expenses. On our present assumption that equally good machinery is used in both cases, there seems no ground for any difference in the cost of repairs and small supplies, except such repairs as may be required to the belting itself.

In the cost of attendance, whatever difference there may be should be in favour of direct connection, owing to the greater compactness of the engine room plant obtainable by this method.

The weights of the rotating parts of dynamo and engine, the strain of the belt connecting them, and the thrust on the crank pin, will determine the resultant pressures and the consequent friction in the main bearings of a belt connected combination. With direct connection the weights are reduced by the absence of the armature pulley and the driving pulley on the engine, there is no belt strain, and the friction is that due to the reduced weight and the thrust on the crank pin, making the direct connected more efficient than the belt connected combination. What saving in fuel this means is a very interesting and important point which could be definitely determined only by an actual fuel test. But there is a most regrettable scarcity of any published engineering data on the subject, and the writer has been unable to find any records of tests which would determine this point. In the absence of such records we may attempt to form some idea of the possible fuel economy by calculation, but for a general consideration of the subject it helps us but little. In the engine the weights and the total belt strain are constant, and act each constantly in one direction at all loads, but the pressure due to the thrust on the crank pin changes its direction each revolution, varies with the load, and not only varies at different points of the stroke, but varies differently for different loads. Without indicator diagrams and without accurate dimensions and weights of the reciprocating parts of the engine, calculation becomes so approximate as to be of little use. Without these we must leave on one side the friction of the belt connected engine, and with it the whole friction of the direct connected dynamo and engine, which at most cannot be greater than for the belt connected engine alone, since the crank pin thrust is the same for both, the belt strain is absent in direct connection, and the weight of the rotating parts of the engine is but slightly increased by substituting the direct connected armature for the driving pulley on the engine shaft. A rough comparison of weights shows an increase of weight on engine bearings for direct connection, averaging 10% for 8 sizes from 25 to 225 horse power, and 5% for 5 sizes from 40 to 125 horse power.

We may then take the friction of the belt connected dynamo as the minimum amount saved by direct connection. Now, this is the same actual power whatever the load on the dynamo may be. It depends on the weight and the total belt strain, which are the same at all loads: as the load increases one side of the belt slackens just exactly as much as the other side tightens. Consequently the per cent. loss in the bearings increases as the load diminishes. If the saving by direct connection is at full load 2½% of the output of dynamo, it is at half load 5% of the output of dynamo, and at quarter load 10% of the output of dynamo. Hence the total saving during a run depends, amongst other things, very much upon the average load on the dynamos during the run.

Reference has been already made to the dearth of published records of the performance of direct connected dynamos or of data concerning them. This is a matter for surprise in view of the early use and subsequent development of the type in Europe. But it is still more surprising that such a large amount of capital should have been invested in them in the United States during the last three years, with so little public notice of the reasons leading to their adoption, or the advantages expected to be gained by their use, and a complete absence of information as to what results have been actually realized; and this paper has been prepared in the hope of eliciting some discussion by this Association which will assist in throwing further light upon the subject.

Mr. Thomson asked Mr. Langton if he considered the slow speed multipolar machine as efficient as the bi-polar machines.

Mr. Langton said the question was rather a wide one, as there was considerable variation in different makes, and the question of the efficiency between the two types was so mixed up with the various makes as to make a general answer impossible.

Mr. Galt thought the President, from his experience in running dynamos, would be able to give some very important information on this subject. For his own part, he thought the more directly you could get the power applied the better, and the whole trend in every part of engineering was in that direction. As illustrating this he referred to modern practice in locomotive and marine engine construction. The proper plan was direct motion without gearing. Belting, he said, was gearing, and if it could conveniently be dispensed with, it was proper to do so. But owing to the complexity of conditions it was hardly possible to lay down any broad rule. There were conditions frequently prevalent which would make it absurd to make use of direct coupling, and again there were other conditions under which it would be equally absurd to use gear. The advantages of direct work were that it simplified the machine to some extent, occupied less space, making it easier to attend, and effected a saving in wear and tear, for it was well known that belting is likely to give out and necessitates constant attention. Speaking of street railway motors, he said he thought the day was not far distant when there would be found direct dynamos on the car axles. It was well known that gears were very troublesome, taking much oil to keep them in order, and very liable to break. For these and other reasons, the more direct the work could be made the more advantageous. But in the present state of electrical and steam engineering it was hardly likely to always get a direct connected engine to suit the speed at which armatures generally run. In England, Germany and France where large powers were developed, it was convenient and economical to have special designs and it was done in that way. With a Corliss engine, either vertical or horizontal, usually running about 100 revolutions per minute, it was impossible to run direct unless you multipoled your dynamo.

After some further discussion by Mr. Medbury, Mr. Galt moved, seconded by Mr. Thomson, that a vote of thanks be accorded to Mr. Langton for preparing and reading the paper.

Mr. E. C. Breithaupt then read the following paper :—

ELECTRIC STREET RAILWAYS.

BY E. CARL BREITHAUPT.

It is not intended to make this paper one of a purely technical nature ; we shall endeavor rather, to present a general review of the subject in hand and a systematic consideration of the problems and difficulties involved, omitting also detailed estimates of cost.

Until comparatively recent years street railways were operated almost entirely by animal power ; steam engines of various forms were used, but the objections to the ordinary form of engine or dummy has confined them to the sparsely populated districts. Cable traction has come into extensive use, and lately also electric traction. Other methods are, however, also competing for public favour ; in Toledo, Ohio, a plant was recently installed in which the motor was operated by compressed air, while another company in Chicago have been experimenting on the merits of compressed steam as motive power. In this system, water is to be heated at a charging station to a temperature corresponding to about 200 lbs. steam pressure and each car is to have a well jacketed reservoir to carry a supply of compressed steam and water ; the motor is a small steam engine of special design to exhaust at a low pressure and operate noiselessly.

Electricity as a motive power for street railways possesses so many advantages over all other systems that it is at present recognized as the best method of propulsion for the great majority of cases. The speed of an electric car can be varied at will; power is consumed according to load and rate of speed, and there is no constant factor of loss as in the cable system ; the cars can be moved forward or backward, they can be started and stopped with surprising rapidity, and are not liable to get beyond control. The system has also its points of inferiority ; the method of transmitting current to the car by an overhead wire line is severely criticized and the accounts furnished by the daily press of the accidents and destruction to life caused by the "deadly trolley" have come to be an old story, though in point of fact only a small proportion of these are attributable to purely electrical causes. The dangers of a street railway service naturally increase as the rate of speed maintained is advanced, and the greatest number of accidents are due to this cause. Cable railways are in reality a greater source of danger than is the line wire of a trolley road.

In electric railway work one of the chief problems involved is how to supply current to the moving motor. A number of different methods have been proposed all of which resolve themselves into two distinct types, and since these affect changes in the entire operation of the road we may classify the whole subject under the same headings, viz :

1. Where the current is generated at a central station and transmitted directly to the car motor by means of a wire line and moving contact.

2. Where a certain quantity of energy is stored up in some form or other and carried on the car itself, there to be supplied in the form of electric current to the car motor. In this case the accumulator is usually an electric storage battery, though other plans have been proposed, in some instances very complicate.

In the first type the transmission of current may be accomplished by an entirely overhead line or by an entirely underground line or by a modification of these as e. g. in the case of the Buffalo street railway, where, we believe, all the feeders and mains are buried and only the trolley wire is overhead. The term "trolley roads" may be applied to all of these. Theoretically considered, the second method is no doubt the more desirable one since it eliminates entirely the difficulties of a transmitting line, but as yet it has not proven itself altogether successful ; in fact the only electrical method which has so far stood the test of a number of years in all kinds of climate is the overhead trolley system of the first type.

The three essential points of any electric road naturally are :

1. The generating plant.
2. The transmitting plant.
3. The motors and car equipment.

Let us consider these more in detail.

GENERATING PLANT.

The location and design of the power station is a matter which should be studied with much care. For roads of the first type it should be as central as possible with reference to the territory covered in order to economize copper and minimize losses on the line. If it be a steam plant it will be of advantage to place it where an abundant supply of water can be obtained for condensing, and near to railway lines and steam ship wharves so that fuel may be brought in without extra outlay for cartage. On the other hand property values must also be considered ; accurate estimates of all the quantities involved must be prepared and to determine where it will be advisable to add to first cost in order to save in working expense the interest on the extra capital so invested, must be balanced against the decrease in working expense thereby effected. That it results in economy to utilize water power for electrical purposes cannot always be taken for granted. Such natural sources of power are generally found at locations more or less inconvenient, often at some distance from the centre of distribution, and the extra outlay for copper and other items of primary investment as well as the increased loss in transmission may assume such large proportions as to bring the net cost per horse power per year above what it would be if steam were used. Moreover, where the load is a variable one, the water power plant will not accommodate itself so well to the fluctuations, and the smoothness of operation obtained in a steam plant cannot be acquired ; this entails a further loss as will be shown later.

In electric railway work of the first type, viz :—where the car motors are supplied with current directly from the generators by means of a transmitting line, the service required of the motive power is much more exacting than in ordinary cases ; the load fluctuates between very wide limits and with great rapidity, particularly so on small roads. This causes not only unusual strains on the machinery and which must all be allowed for in construction, but unless the regulating apparatus responds promptly to a change of load, satisfactory results cannot be obtained. Take for example a road operating six cars altogether, weight 8 tons per car, average speed 9 miles per hour, roadbed rather hilly but grades not over 3 per cent. The power required at the car axle to propel one of these cars on a level would be about 4 h. p., 2 per cent grade 11.5 h. p., 3 per cent. grade 15.5 h. p. If now two of these cars be simultaneously started on ascending grades of say 2 and 3 per cent. while two others are running on level tracks, the remaining ones drawing no current, the load will be increased a little more than three fold, not counting the extra energy required to start, and unless the regulation be prompt they will start slowly.

The ratio between maximum load and mean load is a factor which enters largely into the determination of the prime mover to be employed, both as to size and kind. Taking the same example the maximum load would be somewhere about 100 h. p. at oar axle while the mean might be 35 h. p., depending of course on local circumstances, a ratio of 3 to 1 ; as the total number of cars operated increases, the variations due to a few cars being thrown on or off become relatively smaller, the load tends to even itself and become steadier and the ratio between maximum and minimum may approach unity. It thus appears that the duty required of a prime mover on a small road is more severe than that of a plant of considerable size, a fact which may at first sight seem somewhat surprising. The prime mover employed ought therefore to be one capable of very sensitive and quick regulation, and which, while able to develop the power required for maximum load, should work at its best efficiency at about the average load, and further, this efficiency figure should not vary much for small changes of load.

Of all the different sources of power only two, viz., steam power and water power, are made use of to any extent in electric railway work, and of the prime movers of these two classes the steam engine best fulfills the required conditions. In point of operation its two great advantages are :

1. Its regulation, which though far from perfect, is vastly superior to that of any water wheel.

2. Its range of power ; a steam engine can much exceed its rated output for a short period while a turbine can never develop more than a certain fixed quantity. For this reason a water power plant will usually show greater friction losses.

The style of engine best employed whether high speed or slow speed, will be determined by the sizes of the power units and the ratio of maximum load to mean. It is a matter on which there exists much difference of opinion. High speed engines regulate quicker and they do not require intermediate pulleys to bring up speed ; for these reasons they are mostly used where the power of the station is subdivided into a number of smaller units or where the total output is comparatively small. If each engine be directly belted or directly coupled to one or two dynamos the losses due to counter-shafting are entirely eliminated, and if we install several sets of units more than are actually necessary the liability of a breakdown is reduced to a minimum. Slow speed engines on the other hand better utilize the expansive power of steam and operate more economically, especially where they are used compound condensing and where the units are large. The usual method is to connect all the engines to one countershaft from which in turn all the dynamos are driven, thus enabling any set of dynamos to be driven from any engine, a consideration of some advantage, but we must now also allow for the extra losses due to shafting and we cannot provide so well for a breakdown.

Of the steam generating plant we need not make special mention.

The objection to the use of turbines as prime movers are, as already stated, their slow regulation and the fact that since they cannot exceed their rated output they must often be worked at a low efficiency. The power they exert does not vary strictly in accordance with that required on the line, since their regulation is not only slow but is also hindered by a factor which may be called the time lag, and which is due to the slow action of the governors ; when the external load is suddenly changed the momentum of the station machinery is largely drawn on, and by the time the governor action is felt, its speed may be so much accelerated or reduced that an extra shifting of the gates is needed to restore normal speed. In the tests of the Neversink Mountain railway made during the summers of 1891 and 1892 under the direction of Messrs. H. S. Hering and W. S. Aldrich the general working of turbines as prime movers for railway service was well shown. The existence of the time lag was clearly demonstrated. In one instance the electric horse power dropped abruptly to zero, then rose again to a maximum in fifteen seconds, while the turbine horse power showed a corresponding minimum 35 seconds later and a maximum 45 seconds later; during fouryt-four minutes consecutive running a maximum difference of 140 h. p. was shown between turbine shaft and dynamo terminals and a minimum of only 12 h. p. The speed variations were found to be great and sharp, showing at the turbine shaft a maximum of 104 and a minimum of 78 revolutions per minute during 13 minutes. The voltage keeping pace with the changes of speed rose to a maximum of 550 and fell to a minimum of 260 during the same time; the load during this period was about 45 per cent of the capacity of the station and the gate varied from 41 per cent to 8.5 per cent of full gate. These fluctuations are of course extreme examples. Two vertical turbines were used at that time, coupled to the same shaft but individually governed; the governors did not always act simultaneously, and it happened occasionally that one turbine was driving the other.

In the case of accumulator roads the required conditions of the generating plant are materially changed. The load is now a constant quantity approximately equal to the mean power required to operate the cars, and the rated output of the generating station need therefore only be large enough to accommodate this load. In a paper lately presented before the American Inst. of Electrical Engineers, by Charles E. Emery, Ph., D. the author compares the working expense of engines for constant and variable loads. Assuming that for the latter case the power plant is required to be 50 per cent larger and that a somewhat greater allowance must be made for depreciation on the machinery account, other conditions being the same, he estimates that for a case where the total cost per horse power per year amounts to $52.66 for the variable load it will only be $47.27 for the constant load, both reckoned for 365 days of 20 hours each. A water power is admirably adapted for storage battery roads. The turbines can be operated at their best efficiency and, if the source of power be inconveniently situated, we can easily transmit current to the car barns or any other convenient charging station.

As to the question of cost of steam power or water power we beg to refer to the very exhaustive paper by Dr. Emery already mentioned.

TRANSMITTING PLANT.

In all electric railways of the first type the transmitting plant is of the same form, viz : that of a trolley line with its mains and feeders all radiating from the generating plant and extending over the entire route. In most cases the wires are carried overhead on poles but where the street traffic is heavy, as in large cities, this causes some encumbrance and danger to the public, especially in case of fire, so that it may be found necessary to carry the feeders and mains underground, a matter which entails considerable difficulty and extra expense ; the wires must be better covered and good insulation is much more troublesome to maintain. Since a good conducting path is offered from the trolley to the earth, lightning will be more apt to do injury to the line, though the risk of damage to the station machinery should not be so great as in the case of an entirely overhead line.

A variety of conduit systems were early proposed but the difficulty of properly insulating a bare wire lying below the surface, or of providing other suitable means of contact were found to be so great that they received little attention. Lately, however, a number of conduit roads have been constructed on plans which seem to promise better success. The Love system has undergone a series of experiments in Chicago and a short line was also installed in Washington, D. C., last fall. The conduit used at the latter place is 17 inches deep by 14 inches wide, very similiar in general construction to that of cable roads, and connected to the sewer at frequent intervals to secure proper drainage. A complete metallic circuit is used that leakage may be easier detected and kept as low as possible. Full descriptions of this as well as several other new conduit systems have appeared in the engineering journals and need not be repeated here. We are informed by one of the engineers of the Washington Road that it has so far given good satisfaction, and that during the severe wet weather of the past winter no trouble was caused by water, the leakage being quite small.

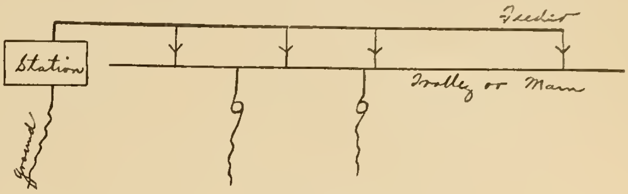

FIG. 1.

In the European cities there are a number of conduit roads in operation which we believe are showing good results, the one at Budapest being perhaps the best example.

Induction systems in which primary coils are to be imbedded just below the surface at regular and short intervals along the track while a secondary is carried low down on the car, have also been proposed ; this would overcome the difficulty of moving connections between car and line, but it carries with it other sources of trouble, and we have as yet no suitable alternate current railway motor.

As to the construction of the line for trolley service ; we want of course to secure as nearly as possible the same potential difference between trolley wire and ground at all points, and to obtain this we must run feeders from the station to different points on the line. We may run out one continuous feeder and connect it to the trolley wire whenever necessary as in figure 1.

The trolley or main may or may not be connected directly to the station.

In this case the diameter of the feeder is decreased as its distance from station increases ; a better method is to run out separate feeders as in figure 2.

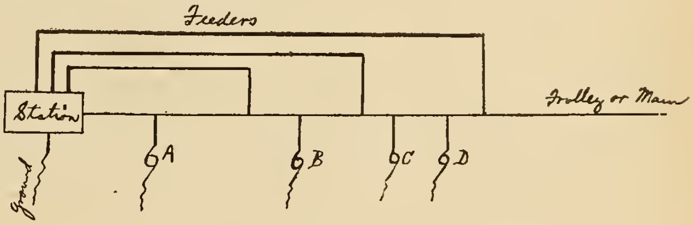

FIG. 2.

To determine the location and sizes of feeders we must find the amount of current required at certain parts of the route, and to do this we need of course to know the particulars of the case. Given then :

The profile of the road,
Car speed and time intervals between successive cars,
Total weight of car and number of passengers it is intended to carry,

we can determine the horse-power required by any car at any part of the road from which, assuming a certain efficiency for each of the different parts of the plant, we deduct the current required on any portion of the line *for the given case* and the mechanical horse-power required at the station.

The proper calculation of feeders is nevertheless a difficult problem as the alteration of any one of the given data will change the result. Take e. g. cars A. B. and C. running at such intervals that their distances from each other is 2000 feet drawing respectively 40, 50 and 60 amperes. If now another car D. drawing also 60 amperes were to follow closely after C. the current required on that section would be doubled, and the line loss increased four-fold ; i. e. the available pressure and efficiency would both be materially lessened. Where the feeders had been calculated just to accommodate a certain service, a change in the running schedule of a road might thus entail rather unexpected results in efficiency of operation. The necessity of having a properly constructed ground return is sometimes overlooked, and complaints of corrosion of lead or iron pipes by electrolytic action are not uncommon. Rails should always be properly bonded and grounded at regular intervals by a wire running into permanently moist earth ; in some cases it is advisable to put down a return wire.

In the case of roads of the second type the accumulators must be considered as the transmitting plant, and these have been the one weak point in storage traction. The batteries mostly used have been the lead and acid cells, of the types originally devised by Plante and by Faure, or modifications thereof. The difficulties in their operation are many and well known; the positive plates do still warp and form a short circuit in spite of all efforts put forth to keep them in line, and grid plugs still continue to swell and drop out. The Waddell-Entz Electric Co., of New York, have been experimenting on a French alkaline battery which shows considerable probability of success. The metallic elements used are copper and zinc and the electrolyte caustic potash. The electromotive force of such a couple is quite small, being only eight tenths to nine tenths of a volt, while that of the lead cells is 2. to 2.4, but its chemical action is almost completely reversible, and its weight is only about 60 pounds per horse power hour, stored, while that of the lead type is about 100 pounds; its efficiency is claimed to be fully equal to that of the best lead battery. The motor used in connection therewith is especially designed for low voltage and has a Gramme ring armature of large diameter with internal field, thus securing a longer power arm and better ventilation. It is wound to take heavy currents so that a powerful torque may be exerted to make up for its slower speed.

MOTORS AND CAR EPUIPMENTS.

The style of motor employed for electric traction work is substantially the same for all of the different systems now in use. In the earliest forms it was carried above the car floor and connected to the car axle by means of belts or chains, but this method was soon abandoned. Link connection between armature shaft and car axle like that of railway locomotives was used to some extent, and the method may yet in a modified form come into use though at present spur gearing is employed almost exclusively, motors being always placed under the car floor. The first spur geared motors were built with two or more reductions, but these have been largely displaced by a gear of single reduction. From a mechanical standpoint the best construction would be to utilize the car axle as armature shaft and do away with all gearing, but electrically this involves some difficulty, since the armature speed must now be comparatively lessened and the armature must have a greater turning moment to make up for the leverage of the gear wheels. In the Short gearless motor this is secured by increasing the armature diameter and strengthening the field. Mr. Short claims that a double reduction spur gear consumes about 15% of the energy supplied to the motor. ("Practical Operation of the Gearless Motor"—S. H. Short, *Electrical World*, April 16th, 1892.)

For regulating the armature speed of a traction motor a number of different methods suggest themselves. For a given armature revolving in a magnetic field of a certain fixed strength the torque varies as the current supplied and the speed varies as the potential difference between its terminals; if, however, the field strength be varied both these quantities will be affected. We can therefore regulate the speed by simply interposing a variable resistance in the external circuit or by changing the strength of the field, i. e., varying the ampere turns on the field coils. In the Edison system a combination of these two methods was used. The fields were wound with a number of separate coils and by means of a controlling switch different combinations of these were affected so as to vary their total resistance and number of turns. Where two or more motors are used an efficient regulation can be secured by throwing the machines in series or in parallel; an external resistance is also used and different combinations can again be produced. This method is now adopted on the Thomson-Houston and Westinghouse equipments and a large saving of power is claimed for it. In this connection we would refer to some interesting curves on motor tests having reference especially to different methods of speed control by Prof. Shepardson and Mr. Birch. (See *Electrical World*, July 9th, 1892.)

Where storage batteries are employed we can regulate quite efficiently by changing the relative arrangement of the cells. We can thus form any number of combinations between all cells in series and all in parallel and so vary the current supplied to the motor both in quantity and pressure. The method should be a very efficient one.

On electric cars we can secure a very powerful brake by short circuiting the motor armature and making the machine act as a dynamo. If properly applied the method is an excellent one; it is not subject to any of the evils of ordinary friction brakes and where storage batteries are used a part of the energy expended in driving the car can thus be recovered. If the road be hilly this results in an appreciable saving of power. The method is used in the Waddell-Entz equipment and gives very good results.

EFFICIENCY OF ELECTRIC TRACTION.

The vital questions in any commercial venture of this nature are of course first cost and operating expense. The cost of construction of an electric road, especially the outlay for line and track construction, can be increased or decreased largely as the circumstances of the case will warrant, and even where the most expensive equipment is called for, the total cost need not equal that of a cable road. In operation the general efficiency obtained is also a fair one. Railway generators of the types now built, have an efficiency approaching 90% even at half load, but we shall take it at 85% to be within the limit, while an average of 70% may be claimed for motors and gearing. Allowing a drop of 5% on the line we should have a total efficiency of 57% between dynamo pulley and car axle. These figures are averages and must be expected to vary widely, particularly so in case of the motor losses. From special car tests made during the test of the Neversink Mountain Road already referred to, we have taken the following table to show the performance of the motors.

Remarks.	Grade %	Mean car speed	Total load pounds	Mechanical h.p. at car axle.	Electrical h. p. at motor term.	Efficiency.
Different positions of regulating switch.	3.5	7.5	23,800	21.6	36.8	58.8 minimum
	3.5	12.2	23,800	35.3	45.	78.5 maximum
Under heavy load.	3.64	7.7	32,900	31.5	51.	62. minimum
	3.64	9.	32,900	40.2	53.3	75.3 maximum

Car equipped with two twenty-five horse-power Edison single reduction class "B" motors.

Weight of car 22,000 pounds.

The total efficiency of the plant was found to be rather small. At 35% of full load it was found to be about 14% between hydraulic horse power and car axle; 30 per cent between power delivered to station machinery and car axle, and about 50 per cent. between dynamo pulley and car axle. At 45 per cent. of full load these figures were respectively 23.1%, 39% and 57%. These results show that the turbines themselves and countershafts consumed a large amount of power; the electric part of the plant was operated with a fair degree of economy considering the circumstances of the case.

For electric roads of the second type where electric accumulators are used the efficiency figure will be higher for some parts of the plant and lower for others; station losses should be smaller than those for trolley roads and motor losses, considering the fact that a part of the energy can be recovered by operating the motor as a dynamo should not be quite so large. The principal waste of energy is in the double conversion from electrical to chemical and back to electrical energy in the storage batteries, and this loss is no doubt a considerable one. Accurate figures have as yet not been published, but the total efficiency of such a road is probably somewhat below that of a trolley road.

Mr. Langton said the figures in the paper regarding total efficiency were very interesting and although the loss would seem very large to an ordinary consumer it was probably much less than from any other form of transmission. He said that it was rather a misfortune for electrical transmission that owing to electrical power being so easily measured the loss was always readily ascertainable, whilst the greater loss by power in other methods of transmission was seldom so accurately known. He remembered a case of a small establishment running by water power. It was discovered that it took 18 horse-power to run the shafting and machinery and 12 horse power to run the shafting alone.

Mr. Breithaupt expressed a desire to hear some remarks from Mr. Langton on the subject of storage batteries.

Mr. Langton said that storage batteries of different makes had been tried in many different places, and had universally failed for traction, and always from the same three causes: the weight was too great, the ampere hour efficiency dropped with heavy load, and the heavy load also caused mechanical deterioration of the plates. Unless the storage battery could overcome these difficulties it was no use for traction. He was interested in a storage battery himself, and if it turned out as was expected he would be happy at some future time to give a description of it, but at the present time it was only wasted time of the Convention to talk of storage batteries.

On motion of Mr. Langton, seconded by Mr. Galt, a vote of thanks was tendered to Mr. Breithaupt for his highly interesting paper.

A vote of thanks to the Press of Toronto for full reports of proceedings having been passed, the Convention adjourned, to meet on the steamer Chicora at 7 o'clock to-morrow morning.

THE EXCURSION.

The excursion to Niagara Falls on Thursday was looked forward to with anticipations of pleasure, not unmixed with anxiety however lest Jupiter Pluvius should insist upon exercising sway over the elements and also for fear that the majority of the members would prove unequal to the task of getting down to the wharf by seven o'clock in the morning. Both these fears proved groundless. The heavily overcast sky which greeted the early risers, dropped a slight shower, but afterwards donned a more amiable mood, and throughout most of the day smiled cheerily down upon the company. For some time after reaching the deck of the handsome steamer "Chicora,' members were engaged in trying to discover who of their friends had succeeded in getting aboard. In some instances a laugh was indulged at the expense of those who were supposed to have failed to make connection, but the joke was on the other side when the absent ones shortly after hove in sight. In fact had the roll been called, there would have been found but a small number of those in attendance upon the convention who would not have responded to their names, and the places of these were filled by ladies, quite a number of whom graced with their presence the occasion.

Queenston was reached shortly before ten o'clock. On disembarking from the steamer the company found a special train in waiting to convey them over the Niagara Falls Park and River Railroad Company's line to Chippewa. A description of this unique and well equipped road having appeared in the ELECTRICAL NEWS for July, it will be unnecessary to enter into details here further than to say that the route follows the windings of the Niagara River for a distance of twelve miles and affords the passenger the best view it is possible to obtain of the historic battlefield of Queenston Heights, the Rapids, the Whirlpool and the Cataract itself, as well as the wealth of magnificent scenery for which the locality is famous. It need scarcely be said that the company found the trip full of interest and pleasure. Half an hour was profitably spent after returning from Chippewa in making an inspection of the power house at the Falls. The building is a most substantial stone structure, and the plant and the manner in which it is installed are most admirable. As yet there is much unoccupied space in the building, but in view of the intention to double track the road, additional plant will probably be put in during the coming winter. A feature of much interest was the method adopted of regulating the current by means of resistance boxes, thus doing away with the necessity of keeping a man constantly employed at a governing wheel as has heretofore been the practice in water power stations. By the new method much more perfect regulation is secured.

From the power house the party was carried to the Cliff House, where luncheon was served. Then a descent was made of the steeply inclined and winding roadway leading down to the river, where, lying alongside her wharf, lay the steamer " Maid of the Mist," in charge of her cheery commander, Capt. Carter, who gave everybody a most hearty welcome, and piloted them safely over the river, landing them at the foot of the inclined railway on the American side.

For a time the apparatus for hauling the cars up the incline refused to work, and quite a number of the members and some of the ladies undertook to make the ascent on foot. Their appearance, especially of those having to carry an abundance of avoirdupois, as they neared the top of the stairs, indicated that they had not fully counted the cost before making the attempt. Eventually however they, with their fellow travellers, whose patience had been rewarded by a speedy ascent in the cars, found themselves once more on the level. Here they were taken in charge by Mr. Harrington, secretary of the Niagara Falls, N. Y., Business Men's Association, and conducted via Prospect Park and a special train of electric cars, to the locality where the great tunnel is being constructed with the object of utilizing the vast water power of the cataract. It is impossible within the compass of this article to enter into a detailed description of this work, which is so unique and gigantic in character as to be the object of world wide attention. The members of the Association were given a look into the wheel pit, which is 170 feet deep, and will contain half a dozen inverted turbines, which are expected to develop 50,000 horse power. The financial results of this undertaking, in which the faith of the construction company is represented by millions of dollars expended in excavation, masonry and plant, will be eagerly looked for.

From this interesting scene the company were conveyed back to the town, and thence by electric elevators to the top of the observation tower, a height of about 300 feet, from whence a magnificent view is obtainable up and down both sides of the river. Having descended from the tower, a few minutes sufficed, aided by the inclined railway to again reach the deck of the " Maid of The Mist," where, doffing hats and bonnets, and encasing themselves in rubber suits provided for the purpose, the excursionists were carried by the powerful little steamer to within a few yards of where thousands of tons of water fell each minute from the crest of the precipice nearly 200 feet above their heads. From this situtation the beauty, grandeur and power of this great exhibition of Nature impress themselves most deeply on the minds of the beholder.

Taking leave of the steamer and re-embarking on the electric cars, the return trip to Queenston was commenced, the terminus being reached at 5 o'clock. Here three rousing cheers were given for Mr. W. A. Grant, Capt. Carter and Mr. Harrington, and subsequently on the return trip to Toronto on board the steamer, a series of formal resolutions were passed expressive of the thanks of the Association for the courtesies extended by the Niagara Navigation Co., the Niagara Falls Park and River Railroad Co., Capt. Carter, representing the owners of the Maid of the Mist and the Niagara Falls Business Men's Association. A resolution was also adopted appreciative of the services of the Executive officers in making the arrangements for the trip.

The unanimous verdict is that a more interesting and profitable feature of the Convention could not have been devised.

ELECTRICAL EXHIBITS.

Below are printed particulars of interesting exhibits of electrical manufacturing Companies at the Industrial Exhibition:

BALL ELECTRIC LIGHT COMPANY.

This company had at the Exhibition the following apparatus: one 1000 light alternating current dynamo with transformers, and complete switch board, fitted with station transformer, ammeter, volt meter, potential indicator, and high and low potential lights, indicating the exact pressure of the current by red and blue lights without the necessity of coming close to the switch board to observe the volt meter. They also had one 800 light direct current generator operating both 110 volt incandescent lights and 220 volt motors. This generator was connected on to a three wiring circuit delivering all the current to the Main Building both for incandescent lights and motors, also operating all the incandescent lamps in their exhibit and five or six motors, among which were a 10, 7½, 5, 3, and 1 horse-power. One of the motors was belted to a 15 light 4 amp. dynamo operating the arc lamps in their exhibit. Connected to the direct current incandescent dynamo were their arc lamps for direct incandescent circuits, and on the alternating dynamo, their alternating current arc lamps. Among the other apparatus shown were recording watt meters, lamp hour recorders, electric heaters, electric curling irons, etc. The exhibit was driven by a Doty high speed engine, the 1000 light dynamo being close belted to one drive wheel by the L. P. D. transmission device manufactured by Darling Bros., Montreal. In another space in Machinery Hall, the dynamo for supplying about 100 Ball arc lamps to the Main Building and Music Pavilion were located, power for these being furnished from a Wheelock engine. It may be noted here that the arc lights for these buildings were in operation constantly from the opening night until the closing without any hitch whatever. The Ball Co have illuminated the Main Building since 1883 or 1884 with the exception of one year, and whenever their lamps have been used in this building it has never been left in darkness. This speaks well for the reliability of the system as it would be a serious affair to have all the lights go out in this building when it is crowded as it usually is.

ROYAL ELECTRIC COMPANY.

The neat and tasty exhibit made by the Royal Electric Company in the Machinery Hall is worthy of more than passing mention. All their apparatus exhibited was in active operation, showing in service their arc, alternating and direct current systems, as well as their motors. The large switch or show board, 24 feet long and 12 feet high, was artistically laid out with all the different articles usually appearing on a switch board, as well as some artistic designs worked out with the various electrical supply articles and incandescent lamps. A large bank of transformers were located at the foot of this board and from which the various lamp signs were operated, giving some very pretty effects Within their enclosure was a large table on which were arranged the different classes and kinds of electrical supplies which this company deal in, and the exhibit was very complete. Last, but not least in point of show and general interest, was the exhibit of electrical cooking and heating utensils, which comprised sad irons, goose irons, polishing irons, tea kettles, tea and coffee pots, stew pan, chafing dish, broilers, toasters, pan cake griddles, heaters, etc. The centre of attraction for old and young was the electric curling irons where moustaches, whiskers, bangs, frizzes and back hair were curled free of charge. Credit is due the Toronto staff of "the Royal" for the taste displayed in the decorations and arrangements for running the machinery and apparatus.

KAY ELECTRIC WORKS, HAMILTON.

The Company's exhibit attracted much notice, consisting as it did of constant potential dynamos and motors in all sizes and voltages. Their motors are adapted for either lighting or power. Each motor is supplied with an automatic self-lubricating journal; the motors are also self-lubricating, so that they are capable of being operated by any person of intelligence.

PETERBOROUGH CARBON AND PORCELAIN CO.

An attractive and interesting exhibit of goods of their manufacture was made by the above Co., Mr. J. W. Taylor, the manager, being most of the time personally on the ground.

BELL TELEPHONE COMPANY.

A prominent feature of the Main Building was the exhibit of telephones, annunciators, fire alarm and police signal telegraph systems, made by the above company. The exhibit was in charge of Mr. N. C. Marshall.

BENNETT & WRIGHT.

This firm, which has recently engaged in the business of electrical contracting in Toronto, had a tasty exhibit of electric apparatus, of which the Eddy motors were a prominent feature and attracted considerable attention. They also had an exhibit of Okonite wires, knife switches, cut-outs, etc.

T. W. NESS & CO.

The exhibit of this Company was illuminated by a magnificent electrolier and a bank of 50 colored incandescent lamps. It embraced a most unique assortment of telephones, switch-boards, &c., (one of the leading lines of goods produced in their factory), main line instruments with Blake or carbon transmitters, for local exchanges and private lines. Several new features in these are shown, one with arm rest which makes the circuit instead of the ordinary hook, another with pull down attachment in place of the side crank. Several styles of desk telephones find a place, also special instruments for affording communication between the different departments of a business house. Special mention must be made of their new patented automatic warehouse 'phone, the invention of Mr. Ness, having an automatic switch attachment which immediately returns to its normal position after being used and receiver replaced. A very large electro mechanical gong is shown, this is part of fire a alarm system the firm is installing at Dundas, but all kinds of electric bells, batteries, push buttons, medical batteries, electric fans, incandescent lamps, electric light sundries are exhibited, also a fine assortment of house annunciators of their manufacture. These are filled with gravity drops.

The firm manufacture a full line of telegraphic apparatus and a spring motor for running the phonograph. A very convenient and inexpensive electro medical generator "The Hill" was kept busy giving shocks to the visitors.

The firm handles the Reliance electric lighting and power apparatus and exhibited a 100 light Reliance dynamo and 500 Reliance motor. The firm had also an interesting exhibit at the Monsreal Exposition. The factory and head offices are located at 749 Craig street, Montreal. The Toronto Branch is located at 106 King street West.

JOHN STARR, SON & CO.

John Starr, Son & Co., of Halifax, N. S., made an attractive display of "Unique" telephones, annunciators, etc., of their own manufacture, as well as general electric supplies. The "Unique" telephones are now in universal use in Canada, both for exchange and private use, and are giving perfect satisfaction. The principal advantage claimed for these is in the transmitter, in which there is no spring or screw adjustment to work loose or become affected by atmospheric changes, etc. The "Star Automatic" annunciator is a great improvement over the ordinary drop, there being no drops to require re-setting, and the vibration shutter is more readily discernible than the ordinary drop or needle. The well known "Samson" Battery, for which this house is sole agents for North America, occupies a prominent position.

This Company manufacture and control a number of excellent specialties, in which they do a large business in Canada, among which is the "Starr" Incandescent Lamp for which a number of points of excellence are claimed.

THE STEAM ENGINE GOVERNOR AND ITS REGULATOR.*

By Fred. G. Mitchell, London.

The matter of governing steam engines for uniform speed and economy in the use of steam becomes more difficult as the size of the engine is increased. It would be safe to say, that this device absorbed more thought, and received more attention from the engineers and practical inventors, than any other adjunct of the steam engine.

In the ordinary governor, the principal part of the apparatuses consists of a pair of balls revolving round a vertical axis, generally driven by mitre-gear. The principle of centrifugal force as embodied in the old Fly-Ball governor of Watts, has been more resorted to than any other, but, aside from this the governor has been so imwroved altered and re-constructed since his time, as to be almost unrecognizable, but still the old principle is there, and also the prominent defects, which so materially interfere with its efficiency.

The first of these is friction which arises from the joints, etc. The second, unbalanced force, that is to say, the same force that would support the balls in any plane, would not raise them to a higher one. The third, the resistance offered to the centrifugal force by weight or spring being not adjusted to the various load and steam pressures.

This is the point on which I wish to be understood, and I might say that a great many builders and practical men have overlooked it.

For example : Take a 200 h. p. engine running 75 revolutions per minute and a 40 lb. spring offering a resistance to the centrifugal force of the governor balls, the balls are revolving in their normal plane, and the spring is expanded or drawn one inch, that simply means that the balls had to store 40 pounds momentum to move that spring one inch. Suppose the steam is cut off at half the stroke, and part of the load was thrown off enough so that the steam would have to be cut off at quarter the stroke, then the balls would have to reach a higher plane, and the spring expanded say another inch, this would mean that the balls would have to store 40 pounds more momentum, which calls for a great increase of speed in the engine. But there would not be so great a variation in the engine if the resistance offered to the centrifugal force was uniform, and still less if the resistance was decreased as the centrifugal force increased, or in other words, if the resistance offered to the balls would balance them at any plane, then the slightest variation would be maintained. It may be illustrated in this way; If we place 100 pounds on the platform of a scale and balance it on or with the beam, it is quite consistent that, if we take 10 lbs. off the platform, we will have to decrease the weight on the beam accordingly, if we want it to balance.

Now we will endeavor to see why the weight or resistance is applied to the centrifugal force of a govenor, if the balls revolving in their normal plane and of course centrifugal force tends out. When the load is thrown off the engine and no resistance offered to the governor by means of weight or springs, at the slightest variation the balls will ascend to the proper plane, but should the load be thrown on the engine, the balls willagain have to come to a lower plane. Their re-action depends on the gravitation of the balls, which does not overcome the momentum without a great reduction in their speed, therefore we will have to place resistance to assist and act with the gravitation.

The economy of a good governor should be appreciated by owners of steam engines because the extra amount of steam required to drive a heavy addition of load on an engine is suprisingly small, provided that the engine can get the steam at the very instant the load is applied and before the momentum of the machinery becomes much reduced, but let the engine once get below the speed, the circumstances will be very different.

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*Paper read at the annual convention of the Canadian Association of Stationary Engineers, Sept. 7th, 1893.

DYNAMOS RUN BY GAS AND OIL ENGINES.

As yet very little has been done in the United States in the way of running dynamos by gas or oil engines, says *Electrical Industries*. Many types, however, of both of these are shown in Machinery Hall. Among those deserving special mention is the safety oil engine, a three and a half horse power machine after the Hornsby-Akroyd patent, and made by R. Hornsby & Sons, Limited, of Grantham, England.

This engine using crude petroleum of 300 degrees flash test is said to consume but three-quarters of a pint of oil fuel per horse power per hour, and as run at this exhibition fuel for it is said to cost less than a cent per hour. The supply of oil is carried in a tank forming a part of the foundation box, and is automatically pumped into the combustion chambers as needed after the machine is started.

The engine is somewhat like the Otto gas engine, and works on the Otto-cycle principle. A hot combustion chamber at the rear end of the cylinder receives oil and air, vaporizes the former, and after mixing it with the air the gas thus formed is exploded by the compression of the piston forcing it into and against the hot combustion chamber. To start the machine, a lamp underneath this combustion chamber is lighted, and a blower provided for the purpose is turned by hand to heat the chamber up to a cherry red. When this is accomplished, which takes but three or four minutes, the light is extinguished and and the chamber is kept hot by the compression and explosion of the oil gas, an explosion taking place once during each two revolutions of the fly-wheel.

This particular engine is belted to a castle dynamo of 24 lamp capacity, and the regulation of speed is very perfect, no variation being noticeable when the load is all cut off or all thrown on. The dynamo was built by J. H. Holmés & Co., of Newcastle-on-Tyne, England, and is of much the same type as the Crocker-Wheeler Dynamo of this country. It is very slow speed for the size, running at not over a thousand turns per minute. There is a large field here for engines of this type as the Americans have scarcely become aware of the fact that oil engines are very useful as well as inexpensive for producing electric currents. The foreign firms at the Fair have already noticed this fact and are preparing to supply the demand.

BOILER COVERING AND THE CONSUMPTION OF COAL.

Some experiments on the influence of boiler coverings on the consumption of fuel, says *Scientific American*, have just been concluded on the railways of south-west Russia. It was found that cooling was more rapid while working than when stationary save when a double covering of felt was used. The heat lost in 24 hours by a boiler was 30 square metres of surface containing water at a temperature of 144°, and exposed to an exterior temperature of 8·5°, corresponded to 133 kilos. of coal if the boiler were uncovered, to 155 kilos. if there were a thin metal covering, to 130 kilos. if there were a double felt covering, and to 103 kilos. in the case of a cork covering. For an average daily consumption of 1,164 kilos., the covering of the boiler represented about 24 per cent. and 8·1 per cent. of the consumption of coal.

TELEGRAM—DELIVERY—SUNDAY LAW.

The Supreme Court of Georgia held, in the recent case of Willingham vs. Western Union Telegraph Company, that where a telegraphic message delivered on Sunday for transmission did not show on its face that it related to a subject matter which would render transmission and delivery a work of necessity or charity, and where there was no averment in the declaration either that the dispatch in question did relate to such a subject matter, or that the telegraph company, its agent or servant, was informed that it had relation to any such matter, the failure to transmit and deliver it on Sunday was not actionable.

A large deposit of white mica has been discovered by Mr. John Wallingford, of Templeton, at Eau Claire, Ont., on the line of the C. P. railway. The quality is said to be equal to the Carolina No. 1 mica.

THE LIFE AND CONSUMPTION OF ENERGY OF GLOWLAMPS.

Messrs. Siemens & Halske have made a large number of accurate tests on this important subject with their own lamps as well as with those of other makers.

From the results which are given in the following table it seems perfectly clear that lamps consuming less than 3 to 3½ watts per candle cannot be recommended for practical use.

The final figures in the first column give the average life of the different kinds of lamps.

	1·5 Watts.		2·0 Watts.		2·5 Watts.		3·0 Watts.		3·5 Watts.	
Burning Hours.	Candles.	Watts.	Candles.	Watts.	Candles.	Watts.	Candles.	Watts	Candles.	Watts.
0	16	1·50	16	2·00	16	2·51	16	3·00	16	3·50
5	13·1	1·85	—	—	—	—	—	—	—	—
10	10·2	2·36	15·3	2·09	—	—	—	—	—	—
15	8·4	2·77	—	—	—	—	—	—	—	—
20	7·8	2·81	13·5	2·38	15·8	2·53	—	—	—	—
25	7·3	2·90	—	—	—	—	—	—	—	—
30	5·7	3·56	12·5	2·52	—	—	—	—	—	—
35	5·6	3·66	—	—	—	—	—	—	—	—
40	5·5	3·70	12·1	2·67	15·7	2·54	—	—	—	—
45	5·6	3·65	—	—	—	—	—	—	—	—
50	—	—	11·9	2·62	—	—	16	3·00	16	3·50
60	—	—	11·2	2·72	15·7	2·55	—	—	—	—
70	—	—	10·7	2·85	—	—	—	—	—	—
80	—	—	9·7	3·06	14·8	2·67	—	—	—	—
90	—	—	8·1	3·58	—	—	—	—	—	—
100	—	—	7·8	3·70	14·0	2·82	16	3·00	16	3·50
110	—	—	7·0	4·03	—	—	-	—	—	—
120	—	—	6·5	4·31	11·2	3·45	—	—	—	—
130	—	—	6·4	4·35	—	—	—	—	—	—
140	—	—	6·4	4·36	10·5	3·61	—	—	—	—
150	—	—	5·9	4·68	—	—	16	3·00	16	3.50
160	—	—	5·7	4·80	9·6	3·91	—	—	—	—
170	—	—	5·4	5·12	—	—	—	—	—	—
180	—	—	5·4	5·20	9·1	4·10	—	—	—	—
190	—	—	5·3	5·20	—	—	—	—	—	—
200	—	—	5·2	4·24	9·1	4·13	15.6	3·10	16	3·50
220	—	—	—	—	8·5	4·36	—	—	—	—
240	—	—	—	—	8·3	4·46	—	—	—	—
250	—	—	—	—	—	—	14·1	3·36	16	3·50
260	—	—	—	—	8·0	4·64	—	—	—	—
280	—	—	—	—	7·6	4·86	—	—	—	—
300	—	—	—	—	7·3	5·02	13·2	3·56	15·4	3·62
320	—	—	—	—	7·1	5·13	—	—	—	—
340	—	—	—	—	6·9	5·28	—	—	—	—
350	—	—	—	—	—	—	12·5	3·72	15	3.71
360	—	—	—	—	6·7	5·34	—	—	—	—
380	—	—	—	—	6·7	5·41	—	—	—	—
400	—	—	—	—	6·7	5·41	12·2	3·79	14·9	3·73
420	—	—	—	—	6.7	5·41	—	—	—	—
440	—	—	—	—	6·7	5·41	—	—	—	—
450	—	—	—	—	6·6	5·47	11·7	3·03	14·7	3·79
500	—	—	—	—	—	—	11·4	4·05	14·5	3·82
550	—	—	—	—	—	—	11·1	4·17	14	3·96
600	—	—	—	—	—	—	10·4	4·36	13·7	4·02
650	—	—	—	—	—	—	10·1	4·50	13·4	4.09
700	—	—	—	—	—	—	9·8	4·61	13·4	4·09
750	—	—	—	—	—	—	9.6	4·70	13·3	4·11
800	—	—	—	—	—	—	9·2	4·70	13·3	4·11
850	—	—	—	—	—	—	9·2	4·87	13·3	4·11
900	—	—	—	—	—	—	9·0	4·94	13·1	4·16
950	—	—	—	—	—	—	8·8	5·05	12·9	4·21
1000	—	—	—	—	—	—	8·4	5·27	12·5	4·32

The average life of glow lamps, therefore, is:

Lamps of 1½ watts per candle	45	burning hours.
" 2 "	200	" "
" 2½ "	450	" "
" 3 "	1000	" "
" 3½ "	1000	" "

SPARKS.

The City Engineer of London, Ont, has prepared a statement of the probable cost of an electric light plant for street lighting.

The Brantford City Council has resolved that the contract for street lighting be granted the Brantford Electric and Power Company for five years, at 23 cents per lamp per night.

The Nova Scotia Power Company has given notice of its intention to operate its lines of street railway by the electric system of motor power.

At the annual general meeting of the shareholders of the Montreal Park and Island Electric Railroad Company, held recently, the following directors were elected: Hon. Louis Beaubien, president; Hon. J. R. Thibeaudeau, vice-president; R. L. Gault, treasurer; Maurice Perrault, secretary; David Morrice, Henry Hogan and M. S. Lonergan.

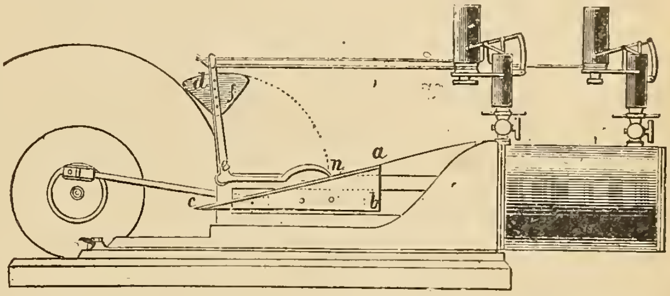
WORKING STRENGTH OF BOILERS.

The following table gives the safe working strength of single riveted and of double riveted boilers of various thicknesses and diameters, allowing a factor of safety of six, and using iron of 50,000 pounds tensile strength per square inch. The single riveted shell is assumed to be 56 per cent. as strong as if non-riveted; the double riveted, 70 per cent.:

DIAM.	THICKNESS	SINGLE RIVETED.	DOUBLE RIVETED.
Inches	Inches.	Pounds.	Pounds.
48	¼	49	62
	5-16	61	76
50	5-16	58	73
	⅜	70	88
52	5-16	56	70
	⅜	67	84
54	5-16	54	68
	⅜	65	81
60	5-16	49	61
	⅜	68	71
66	⅜	53	65
	7-16	62	76
72	7-16	57	71
	½	65	81

A NOVEL INDICATOR GEAR.

In testing an engine at Sibley College, as described in *Cassier's Magazine*, Prof. Carpenter employed a form of indicator gear which, to us, is novel, and as it has some features which should make it useful and convenient, we append a description of it with illustration. To reduce the motion of the piston to the travel of the indicator barrel, there is attached to the cross-head of the engine an inclined plane in the form of a triangle, *a*, *b*, *c*, the side, *c*, *b*, of which, is made slightly longer than the stroke of the engine, and the side, *a*, *b*, is made a little longer than the desired travel, or diagram length. Pivoted at the end of the slide bar is a bell crank lever, *d*, *e*, *n*, in which *e*, *d*, is equal to *e*, *n*. The angle, *a*, *c*, *b*, is thus such that its tangent $=\frac{t}{s}$, s being the engine stroke and *t* the diagram length. This, of course, on the basis of the bell crank lever being equal armed.



The end, *n*, of the bell crank, slides on the sloping face of the cam, and the indicator cord is attached at *d*, and the arm *e*, *d*, is of course to be exactly vertical when the engine is at mid-stroke. The motion is not exactly correct, as shown, for the point *d* rises and falls as it traverses its small arc of motion, but this may be corrected by adding a curved rim to the lever on which the cord may wrap; this rim to be struck from the centre, e. We have added this circular segment, *f.* Theoretically, too, *n* should be a knife-edge, to ensure accuracy. The convenience of this device is felt when taking many diagrams. The lever, *e*, *d*, may always be held back, so that *n* is held clear of the cam, and no movement is given to the indicator, and it can be as easily released into working position again. There is no fumbling with cords or taking up slack, and no frantic grasping after the cord hooks or the little tent rope tighteners; but once fixed to length, the indicator cords may be left undisturbed. The inertia effects are said to be small, and there is not a great deal of cord to stretch and render the diagrams untrue. Brass wire is said to be a very unstretchable material for the cord, and we have tried it though not with special success in general work. The device, however, with its fixed and continuously stretched cords, appears to offer a chance for using wire without the disadvantages which, perhaps, others than the writer have found to appreciate it.

A charter has been applied for the formation of a company to build an electric street railway from Galt to Berlin. Mr. T. M. Burt, manager of the Berlin and Waterloo Street Railway, is one of the directors.

The Port Arthur Electric Railway is now completed. It connects the three towns, Port Arthur, Fort William and West Fort William, and is eight miles in length. Trains run between these towns at intervals of one hour.

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Correspondence is invited upon all topics coming legitimately within the scope of this journal.

THE "CANADIAN ELECTRICAL NEWS" HAS BEEN APPOINTED THE OFFICIAL PAPER OF THE CANADIAN ELECTRICAL ASSOCIATION.

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Information regarding examinations will be furnished on application to any member of the Board.

THE Toronto electric light and gas companies are said to be greatly agitated by the statement of Mr. E. A. Macdonald that when his canal scheme materializes the millions of dollars invested by these companies will not be worth 5 cents on the dollar.

In order to present our to readers full reports of the recent electrical and engineering conventions, it has been found necessary to add twelve additional pages to the size of this number of THE NEWS. After having done this we are compelled to hold over a number of interesting articles, including most of the papers read at the engineers' convention, and the second instalment of Mr. Tesla's lecture.

The Convention of the Canadian Association of Stationary Engineers in Montreal last month was the most important that has yet been held. A new and valuable feature of the two last conventions was the papers on engineering subjects and the discussion thereon. This feature is one which is directly in line with the main object of the Association, namely, the improvement of the educational status of engineers. To the western delegates the visit to Montreal was one of much pleasure and profit, and the generous hospitality meted out to them by their Montreal brethren, and by the citizens of Montreal, impressed them with pleasant recollections of the occassion. The success of the Montreal meeting should prove an incentive to the officers and members of the Executive and Subordinate Associations to push on with increased earnestness the work in which the Association has already achieved such encouraging success.

THE third Convention of the Canadian Electrical Association, to a report of the proceedings of which much space in this number is devoted, was in every way a most emphatic success. The papers were of a high order, and gave rise to interesting and valuable discussions. By means of papers such as the one presented by Mr. McFarlane, the Association will be the means of collecting much interesting data concerning the early history of electrical matters in Canada which might otherwise be lost, and which will form a valuable record in years to come. The Association was fortunate in having present at this Convention, not only members from all parts of Ontario and a good delegation from Quebec, but also representatives of the Northwest Territories and British Columbia in the persons of Mr. Alex. Taylor, of Edmonton, and Mr. H. W. Kent, of Vancouver. Next year when the Convention shall be held in Montreal, it is hoped that Nova Scotia and New Brunswick will also be represented. The decision to have the next Convention in Montreal will no doubt tend to give the Association a more cosmopolitan character. Our advices are that the selection of that city for the Convention of 1894 has given rise to a feeling of much pleasure amongst the electrical fraternity, and doubtless no effort will be wanting on their part to insure its success. The re-election of the chief executive officers for a third term was to them at least a quite unexpected turn of events, and must be regarded as implying entire satisfaction on the part of the membership with the manner in which they have discharged their duties. The steady increase in membership is a gratifying sign of progress. If during the coming year members will individually put forth effort, the Association at the next Convention will show a membership of 200.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

PROCEEDINGS OF THE FOURTH ANNUAL CONVENTION.

THE Canadian Association of Stationary Engineers met in annual convention in Engineers' Hall, Craig street, Montreal, at 10 o'clock a.m. on Thursday, Sept. 7th. The proceedings, in pursuance of the programme published in the ELECTRICAL NEWS for September, extended over three days. The delegates from the various associations outside of Montreal were met by the local brethren on their arrival in the city and escorted to the City Hotel where arrangements had been made for their accommodation. The various Associatious were represented by the following delegates :

Montreal, No. 1.—Bros. J. J. York, H. Nuttall and J. G. Robertson.
Montreal, No. 2.—Bros. A. Latour, R. Drouin and J. A. Hartenstein.
Toronto, No. 1.—Bros. G. C. Mooring, G. Gilchrist and W. Sutton.
Hamilton, No. 2.—Bros. P. Stott and D. Robertson.
Brantford, No. 4.—Bro. T. Pilgrim.
London, No. 5.—Bro. H. Gildhart.
Guelph, No. 6.—Bro. R. W. Green.
Ottawa, No. 7.—Bros. J. H. Thompson and F. Robert.
Dresden, No. 8.—Bro. T. King.
Berlin, No. 9.—Bro. Angell.
President.—Bro. A. E. Edkins.
Vice-President.—Bro. Geo. Hunt.
Secretary.—Bro. W. G. Blackgrove.
Treasurer.—Bro. R. Mackey.
Conductor.—Bro. C. Heal.
District Deputy (Montreal).—Bro. Thos. Ryan.
" " (London).—Bro. F. Mitchell.
" " (Guelph).—Bro. J. A. Angell.
Doorkeeper.—Bro. F. Robert.
Also Bros. A. M. Wickens and Chas. Kinsey.

The convention opened with the following address of welcome from District Deputy Bro. Thos. Ryan.

"As District Deputy of this city, I am called upon by the brethren of Montreal No. 1 and St. Laurent No. 2 to address a few words to you previous to the opening of this convention.

"At last year's meeting in Hamilton it was decided that the convention of '93 should be held in Montreal, and the brethren here were very much pleased at this decision and thank you for it. I know it is a long distance for many of you to come, but I sincerely hope that when you return you will not regret the labor and inconvenience it has caused you.

"As the humble representative of Montreal No. 1 and St. Laurent No. 2, I now bid you all a cordial and a hearty welcome to our city and our hall. I am pleased to see so many of you present and would be still better pleased to see a larger number. I trust your stay here will be a pleasant one. A committee has been appointed to look after your comfort and entertainment, and I hope they will do their duty. This committee has also published a Souvenir Number of this convention, which we trust will meet with your approval and acceptance. A copy will be placed in the hands of each member of the association. The programme of the three days' proceedings is in your hands, and will be carried out as far as circumstances will permit.

"I hope that the deliberations of this convention will be the means of improving the working of our subordinate lodges, and tend to strengthen and combine the whole body in the bonds of brotherly love and friendship. As a district deputy I have not much to say. Unfortunately this district of Quebec is so far composed of but Montreal No. 1 and St. Laurent No. 2. I hope in another year it may be different. With regard to the two associations of this city the utmost peace and harmony have prevailed between them. They are slowly but surely progressing, not so much perhaps in the way of numbers as in the quality of the material.

"I will not detain you further, but simply close by wishing that you may all have a good time and enjoy yourselves thoroughly, and that the convention of 1893 may always be looked back upon with pleasure and profit to all."

After the appointment of a committee to draft a reply to the address of welcome, and the reception of the report of the committee on credentials, the President, Mr. A. E. Edkins, delivered the following address :—

PRESIDENT'S ADDRESS.

Another year has been added to the life of this organization, since we met last in convention to advise each other and to legislate for the different associations which we are again here to represent.

It is then, brethren, with no small degree of pleasure that I take this opportunity of addressing a few remarks to you, at the commencement of what has every prospect of being the most successful convention that this association has yet held.

When I look around in this hall and see the well-known faces of such old friends of, and indefatigable workers for, our association, as are here assembled to-day, I am at once convinced of the fact that the subordinate associations have used good judgment in their selection of delegates to represent them on this occasion. I am pleased to be able to report that during the past year the work of organizing new associations has progressed favorably, owing chiefly to the able assistance which has been rendered me by the District Deputies. New associations have been organized at Guelph, Ottawa, Berlin and Dresden ; all of which are now good, strong associations, and are pushing the good work in their several localities.

A large amount of work has been done towards organization in Deseronto, Galt, Seaforth, Goderich, Halifax, N. S., and several other places, which we trust may be productive of good results in future.

There has been for some time past an Association of Stationary Engineers working in Kingston, Ont., and I have tried to induce them to take out a charter from the Executive Council, and thus become one of us, but unfortunately (I consider both for you and us) I have not yet been successful in doing so. I am given to understand that the Kingston Association is working on precisely the same lines as the C. A. S. E., and will, I trust, be working under one of our charters in the coming term.

I took on myself the responsibility of inviting our brother engineers in Kingston to send a representative to this convention, and I have every reason to believe that in the event of their doing so he will be heartily welcome among us. I trust that during this meeting the members and delegates will be on hand promptly, at such times as may be arranged for the transaction of business, in order that the work of the convention may not be delayed.

I notice in looking over the programme that ample time has been set apart for pleasure and recreation by the Entertainment Committee, so that there will be no need to allow that to interfere with business. There will, I have no doubt, be several matters of importance to the association brought up during this meeting for your consideration, and I would ask you to give the same your most careful attention, keeping in view at all times the fact that you are here as the choice of your respective associations to legislate for and in their best interests, and in doing this you will keep in view the best interests of the C. A. S. E., as a body.

I would respectfully ask this convention to take some steps for the payment to Toronto No. 1 Association of the amount due it for the supplies and stock which were handed over to the Executive when that body was formed. This is a matter which should have been attended to long ago, as it now appears to have assumed the shape of a grievance between some of the members of Toronto No. 1 and the Executive, and is always brought up in the event of an account being rendered by the Executive against Toronto No. 1. I would therefore suggest that this convention take steps towards the payment of said claim. I have noticed during the past year that we are gaining ground with the manufacturers, many of whom have, when requiring an engineer, sent to the association in place of advertising in the daily press. This should be very gratifying to us ; and I trust that during the coming term each member will make it his business to bring the association and its work to the notice of his fellows in some way or other. It appears to be a hard matter to gain the confidence and good-will of the Canadian steam user (with of course some exceptions).

We are building up an organization of which we can be proud. Our motto is Safety, Reliability, Economy and Intelligence. Each of these characteristics is indispensable to a competent engineer. The objects of our association are the elevation of the stationary engineer, helping each other in time of sickness, and the education of each other in the most approved and economical methods of steam engineering. We leave the matter of wages to be settled between each individual and his employer, as we recognize the identity of interest between them, and we do not, neither will we, countenance any project or enterprise that may interfere with perfect harmony between them.

One would suppose that any organization working on these lines would at once receive the hearty co-operation of all steam users. Yet such is not the case, and why I am at a loss to apprehend. We invite our employers to become honorary members of the association and attend any or all of the meetings, and see for themselves as to the work we are trying to do. Yet in the face of all this, many of them appear to look on us with a certain amount of distrust. I know for a fact that in the Province of Ontario a great deal of harm has been done by some of the members of the Local House, who, after wasting their own time in filling an arm-chair during the session, have gone back to their constituents and told them how the stationary engineers' "Labor League" had tried to pass a law to compel all steam users to employ only engineers holding certificates, whose services would be worth so many dollars per day. This has been done to my own knowledge, and has been the means of raising much opposition against us in some places.

But this association can afford to ignore such things. We are, as I said before, gaining ground, and a good cause must triumph eventually. We can now count as our friends many steam users and engineers also, who, at the organization of the association, were very much opposed to us, and I firmly believe there is a great future for this association.

I trust to see the day when there shall be an association in every town in Canada where fifteen engineers are employed. The great difficulty in organizing new associations appears to be owing to the fact that in many towns the engineers themselves seem very indifferent toward their own education and advancement in their chosen calling; and in such cases we can only wait till their eyes are opened, so that they can see things in their proper light. In some towns associations might be formed but for the fact that some of the engineers will not join, and try all in their power to throw cold water, as it were, on the scheme, in order to discourage the rest. And some complain of the cost of maintaining an association, and give as their excuse that they can't afford it. This, as you all know, is a mistake, as the associations wherever formed have eventually been the means of doing an amount of good largely in excess of the cost of maintenance. In localities where engineers themselves have no ambition in the way of self-improvement, it would in my estimation be a mistake to start an association, as it would soon be suspended. But in places where even ten good members can be enrolled, who will meet together for mutual instruction in their calling, I believe that such associations would be productive of much good to all concerned.

Now a few words in reference to the future prospects for engineers. It has been said frequently during the last few years that no engineers would soon be required owing to the electric motor coming into use for driving machinery. That many small steam engines have been replaced by electric motors I am well aware; but as a rule no engineer was employed in charge of these small engines, and therefore (with few exceptions) few engineers have been thrown out of employment. It amounts to this: For every h. p. of work performed by an electric motor there might be an amount of power generated somewhere, somewhat in excess of that h. p., owing to loss in transmission, and with very few exceptions, where water power is available, we find the prime mover is a steam engine of the most approved type, and often of from 500 to 1,000 h. p. and upwards, in a central station, Now, from the very fact that these small power steam engines are being supplanted by motors, and large central power stations are being built and fitted up with engines and machinery of the most approved type, there must naturally be a demand for engineers capable of taking charge of such machinery; and those engineers who have made a study of their work and can handle the indicator and demonstrate in a practical way their ability to secure the best results from a given quantity of fuel, will have no difficulty in securing positions at a good salary. I must also, in considering the question, draw your attention to the thousands of engines and plants which are being erected in all parts of the civilized world to supersede that most faithful friend of man, the horse, in operating street and suburban railway cars.

These things and many others, point to the fact that the old reliable machine known as the steam engine is still rising, and even though it has done so much for the human race in the past, the day has not yet come when the inventive genius of man has produced anything to take its place.

Every little while some genius will startle the world with the announcement that he has invented a machine that will work wonders, produce something from nothing, or produce a revolution in steam engineering, but it generally commences in wind and ends in smoke, and the usual result is that after the end, there are some people in the world who have more sense for the future, but sometimes much less money to their credit in the bank.

The Secretary and Treasurer will in due time present their reports, when you will have an opportunity of seeing the financial and numerical standing of the Association.

In conclusion, I must congratulate you on your choice for a place for the meeting of this convention. Montreal is a city of which we all as Canadian citizens feel proud, and we accord her the honor of being the commercial capital of this, the best and most prosperous country on the face of the earth. There is much to be seen in this city to interest engineers, and this, together with the arrangements which our worthy brothers of the Montreal Association have made for our enjoyment during our stay here, will I am sure prove no small factor in making our visit enjoyable. And when we shall again return to our homes we shall bear with us fond and tender recollections of our Montreal brethren, her citizens, and friendships formed and renewed, during the C. A. S. E. convention of 1893.

SECRETARY'S REPORT.

The report of the Secretary, Mr. Geo. Blackgrove, is as follows:—

"In presenting to you my annual report, I regret that I am unable, owing to the neglect of the secretaries of two or three associations, to give you as good a report as I would like. The negligence of secretaries in this respect was referred to at our last convention, in Hamilton. It is both tiresome and annoying having to write frequently for reports from the various associations, and to receive them half filled out. Bro. F. Robert, of Ottawa No. 7, deserves great credit for the manner in which he has written up his report. I wish I could say the same of all secretaries. It must be understood in future that when the Ex. Secretary writes for a report of an association he should receive it, and not be delayed till the last moment and in some cases till the convention has opened. I would recommend that the Ex. Secretary have power to order blank forms, and each association be supplied with the same for making out their semi-annual reports, and to be forwarded to the Ex. Secretary within thirty days.

The past year has been one of success as regards the formation of new associations, no less than four having been instituted, mainly through the efforts of Bros. Edkins, Mitchell, Angell and others. The names of the new associations are as follows: Guelph No. 6, Ottawa No. 7, Dresden No. 8, Berlin No. 9. It is very encouraging to know that engineers are awaking to the fact that something must be done in order to better the condition of steam engineering, and that that can best be done by banding themselves together and helping each other in the knowledge of steam and everything pertaining to the same. I think it will not be long before we will have other associations formed throughout the country.

I have had several letters from engineers asking the necessary information in regard to becoming members of an association.

The associations now in existence have prospered during the year just passed, and it is the wish of your humble servant that they may continue to do so."

On motion of Bro. J. J. York, a resolution was unanimously adopted congratulating the President upon his able address.

The report of the Treasurer showed that the Association's income during the year ending August, 1893, had been $284.89, and the expenditure $108.53, leaving the balance in hand $221.71. The report was referred to the Auditing Committee.

Committees were appointed as follows:—"Constitution," Bros. King, Pilgrim, Sutton, and Gildhart; "Correspondence" and "Good of the Order," Bros. York, Mooring and Latour; "Mileage," Bros. Stott, Hunt and Angell.

It was decided by resolution that the valuable services performed on behalf of the Association by Bros. Edkins and Wickens should be recognized by the presentation to them of suitable testimonials, and that the presidents of associations on retiring from office in future should receive an appropriate jewel.

A committee consisting of Bros. Ryan, D. Robertson, Thompson, Heal, King, Drouin, Angell, Green, Mitchell and Devlin was appointed to devise means of carrying out the wish of the association in these matters.

This concluded the business of the first session.

The afternoon was pleasantly and profitably occupied with a drive about the city, and in making an inspection of the Dominion Line Steamship "Vancouver" and the Montreal Exposition. The members were welcomed and entertained on behalf of the Exhibition management by Messrs. G. W. Sadler and S. C. Stevenson.

EVENING SESSION.

At the evening session Bro. A. M. Wickens read a most interesting paper on "Wasted Heat."

Bros. Heal and Mooring were of opinion that Bro. Wickens would better have interpreted the meaning had he used the word "convection" instead of "radiation," and Bro. Wickens after some consideration, came to be of the same opinion.

In reply to the enquiry of Bro. Mooring, what engine it was that would give one-horse power for each 12½ lbs. of water evaporated, Bro. Wickens stated that the triple expansion engines on some ocean liners showed efficiency at the rate of 12½ lbs. of water per horse-power. Many engines carrying steam at 160 or 170 lbs. pressure showed a consumption of water equal to that rate; many on the other hand, with a pressure of say 130 lbs., did not make such a great showing. Some, even at the present day, showed a consumption of 60 lbs. per horse power.

Mr. Chas. Kinsey then read a paper on "The Duties of Engineers Twenty Years ago as Compared with the Present Day."

A hearty vote of thanks was tendered Bro. Kinsey for his paper.

Mr. Fred. G. Mitchell followed with a paper on "The Steam Engine Governor and its Regularity."

Bro. Edkins stated that the author of the paper to which they had just listened was himself the inventor of a very efficient governor.

Bro. Wickens expressed the opinion that a governor was wanted which would have no spring; such a governor would be more reliable than those at present in use. The slightest inefficiency on the part of a ball governor rendered it valueless. He advised engineers to study carefully the action of governors, and by so doing they would frequently be able to increase their efficiency.

Bro. Mitchell said that if the balls were revolving in a normal plane and if there were no equilibrium created by a spring, the slightest variation caused the balls to ascend to a higher plane. Something was necessary to act in unison with the gravitation, to offer sufficient resistance to centrifugal force.

Bro. York expressed his high appreciation of the value of the papers to which they had listened, and thought the Montreal associations had not paid sufficient attention to the discussion of engineering subjects.

Bro. Green said a spring with sufficient tension to draw back the governor was essential.

Bro. Hunt's experience with engines of various kinds lead him to believe that a spring was necessary where the speed was variable.

The session closed with a vote of thanks to Bro. Mitchell for his instructive paper.

SECOND DAY.

Fraternal greetings were read by the President from the National Association of Stationary Engineers in convention assembled at Cleveland, Ohio. A fitting response was wired to Cleveland.

The report of the Mileage Committee showing the mileage of delegates to amount to $105.15, was received and adopted. To this amount was added on motion of the President the mileage of the delegate of the Kingston Engineers' Association, Mr. Devlin, who attended the convention by invitation of the Executive.

The report of the Auditors was adopted.

Bro. Hunt suggested that the Association should publish each year a souvenir book, similar to the one got up by the Montreal brethren for this convention.

Bro. Mackey moved that a Committee consisting of one member from each Association be appointed to canvass for advertisements and supervise the publication of the book.

This motion was defeated in favor of an amendment by Bro. York that the matter be left entirely in the hands of the Executive.

Bro. Robertson suggested the desirability of forming engineering libraries in the various localities for the benefit of members of the different Associations.

A letter of acceptance of the kind invitation tendered the Association by Prof. Bovey to inspect the buildings and laboratories of the Department of Applied Science of McGill University, was ordered to be forwarded to that gentleman.

A photograph of the London Association was presented by Bro. Mitchell to the Montreal Association.

At the afternoon session the convention adopted the report of the Committee on Constitution and By-laws which recommended that the article regarding the sending of delegates to the Convention should be amended to read "Each association of twenty-five members should have one delegate, and one delegate more for any fractional part of twenty-five, always provided that the fractional part should not be less than ten, and always provided that no association have more than three delegates."

It was resolved at the suggestion of Bro. York, and on motion of Bros. Thompson and Latour, that a fine of $1.00 should be imposed on Secretaries of subordinate associations who may fail to send in proper returns, and that every member should understand that it is regarded as his duty to address the meeting once at least on some subject.

To the Secretary and Executive was delegated the appointment of a committee to print the "constitution" in pamphlet form, which the subordinate associations might purchase at 10 cents per copy.

In a discussion which took place at this stage on the best class of steam engine, Bro. Wickens said that only those who had had especially good opportunities for observing could feel justified in saying which was absolutely the best. The report of the manufacturers was scarcely to be relied upon. He believed that for railway work the upright triple expansion engine was the best.

Bro. Hunt remarked that at Chicago, where they had all sorts of engines, it was a growing conviction that the triple expansion was not entirely satisfactory. For railway work no doubt it was good, but recent tests showed that the moment the load was thrown off the intermediate cylinder formed a drag upon the high pressure. For this reason engineers were beginning to look with doubt upon this form of engine for general purposes.

After the close of the session the delegates were taken to Lachine and given a run down the rapids.

THIRD DAY.

The first business before the convention was the election of officers which resulted as follows :—

President, Bro. Geo. Hunt, Montreal, (by acclamation); Vice-President, Bro. Wm. Sutton, Toronto ; Secretary, Bro. John J. York, Montreal ; Treasurer, Bro. Geo. Blackgrove, Toronto ; Conductor, Bro. T. King, Dresden ; Door-keeper, Bro. F. Robert, Ottawa.

Votes of thanks were passed to the retiring secretary, Bro. Blackgrove, and to the Scrutineers, after which the delegates visited McGill University, and under the guidance of Prof. Nicholson were shown many objects of interest.

On the opening of the afternoon session, Mr. W. B. Shaw read an instructive paper on "Electric Motors."

In reply to Bro. Wickens' request for an easy method of testing the loss in motors, Mr. Shaw said that many instruments were required for the purpose. About 80 per cent. was he thought about the present average efficiency of motors.

Bro. Wickens in moving a vote of thanks to Mr. Shaw for his paper, said he did not think engineers need fear the introduction of electricity. No doubt in some places where but little power was required, motors were decidedly coming into use, but it was only in such comparatively small places.

Bro. Kinsey said a 15 h. p. engine would cost about $750 per year. But according to Silvanus P. Thompson, who certainly would not be inclined to minimize, the ordinary efficiency of an electric motor is sometimes 60 per cent., very often 70 or 80 per cent., and by no means infrequently as low as 50 per cent. A 15 horse-power motor often really means, therefore, a 7½ horse-power motor, and at this rate would cost $1,500 a year. An engine would heat, or help materially in heating, a building in winter, whereas when electricity was employed this was an extra expense. Armatures also were so liable to burn out. An armature of a 15 horse power motor in one year would cost as much as an engine in twenty years, and it was not nearly as reliable as an engine. In small shops where only two or three horse-power was required, the motor was a fine invention ; also in places where shafting could not be put up. But a motorman's time was entirely taken up, whereas an engineman had plenty of time in which to do other work.

Bro. Edkins wished to know what time the previous speaker considered that engineers had for other work.

Bro. Kinsey stated that he had intended to refer to engineers in charge of small plants.

Bro. Mooring said that a plant of over 10 horse-power was certainly cheaper than electricity, and electricians admitted this. With regard to the heating of an ordinary building by means of the engine, only a part of it could be heated by exhaust steam.

Bro. Sutton did not think engineers had much to gain from the study of electricity. Steam was easier to handle than electricity, and if ever he touched electricity, he trusted it would be with only one hand at a time.

Mr. Shaw responded by saying that for his part he never cared to come near a steam engine unless there happened to be a stone wall between it and himself.

Bro. Hunt said that in the use of both steam and electricity precaution was necessary.

Bro. York referred to the need for better ventilation in manufactories. As a remedy he suggested that steam pipes be put in the basement, all in one room and a pipe carried from there to the room requiring heating, the air being propelled by means of a fan. From the top of the room a pipe should carry the foul air to the outside. This would secure good ventilation, as well as heating. Some might think the above was an expensive way of heating a building. The first cost was perhaps greater, but the cost of maintenance afterwards was certainly less. The association should endeavor to induce manufacturers to initiate methods of heating their buildings. The object of keeping the windows of factories hermetically sealed seemed to be to save heat.

Bro. Nuttall thought it was rather due to ignorance of health requirements.

Bro. Robertson instanced a case which had come under his attention in which the heating of a factory building was done by means of a coil consisting of 7,500 feet of one inch pipe, and a fan running 210 revolutions per minute, which induced a constant supply of freshly heated air in the building, and in moderate weather was very effective and easily regulated.

A unanimous vote of thanks was on motion of Bro. Mooring, seconded by Bro. Wickens, accorded to Mr. Shaw and Bro. York.

On motion of Bro. Mooring, seconded by Bro. Gilchrist, the Executive was instructed to pay on account of its indebtedness to Toronto No. 1, the sum of $25 per year.

The City of Toronto was selected as the place for holding the next annual Convention.

The newly elected officers having been installed and votes of thanks passed to the retiring officers, Bros. Edkins and Wickens were each presented with a testimonial in pursuance of the resolution passed at a former session.

District Deputies were appointed as follows :

Prov. Dist. Dep. for Ontario—Bro. A. E. Edkins.
" " " Quebec—Bro. Thomas Ryan.
Dist. Dep. for Hamilton—Bro. R. Mackie.
" " London—Bro. F. G. Mitchell.
" " Guelph—Bro. J. A. Angell.
" " Montreal—Bro. J. A. Hartenstein.
" " Toronto—Bro. A. M. Wickens.

The Committee appointed to draft a reply to the address of welcome submitted the following :

"In reply to the address of welcome tendered the Executive Council and visiting brothers by Dis. Dep. Bro. Thomas Ryan to this great, prosperous and beautiful city, the commercial metropolis of our fair Dominion, a city whose fame for hospitality is not excelled in the world, we desire to express our sincere and heartfelt thanks. That our visit will be instructive, profitable and pleasurable we feel confident. The arrangements made for our comfort and convenience and for the transaction of our business show great forethought on the part of your committee appointed for that purpose, and we are sure that they have not been excelled or even equalled in the annals of our conventions. That the convention of 1893 will be long looked upon as a landmark in the history of our progressive order is a certainty. One of the many pleasurable surprises, which is a new feature of more than ordinary merit, is your beautiful souvenir. For its compilation and mechanical work it cannot be excelled, and in circulating it among our employers and brother engineers, we have no hesitation in stating that the results for the benefit of our Order will be immeasurable.

(Signed) CHAS. HEAL.
A. M. WICKENS.

Bro. Edkins stated that a balance of $50 remained in the treasury.

After having passed a vote of thanks to the Entertainment Committee, the proceedings of the convention terminated.

THE ANNUAL DINNER.

Of the many features of the Stationary Engineers Convention none possessed half as much attraction from either an instructive or pleasure point of view, as did the banquet on the evening of the 8th, tendered to the visiting delegates by Montreal Association

No. 1. There was a large attendance and the speeches of the evening were both practical and interesting. In all 60 persons sat round the festive board in the spacious dining hall of the City Hotel. An excellent menu was provided by Mr. Lewis, proprietor of the hotel, and nothing conducive to the thorough enjoyment of the evening was omitted. Everybody was good natured, and soon caught the spirit of the occasion, and from the first word spoken in opening the entertainment until the last note of the National Anthem died away, the programme was carried out in a delightful manner. Mr. Joseph G. Robertson, President of Montreal No. 1, occupied the chair. On either side of him at the head of the table were, President A. E. Edkins; Past President, A. M. Wickens; Vice-President, Geo. Hunt; Secretary Jno. J. York; and Mr. Wm. Furgeson, Mr. Fred. Lytle, Mr. Frank Boyd and Mr. Thos. Clarke, representing the Brotherhood of Locomotive Engineers. Among the invited guests were, Messrs. Hugh Valance, Walter Laurie, P. Cowper, O. E. Grandberg, W. B. Shaw, J. A. Darling, W. E. Gower, S. Fisher and others. Letters of regret at not being able to attend and bearing good wishes to those present, were read from Messrs E. O. Champagne, A. Holden and Captain Wright.

At 10.30, ample justice having been done to the bill of fare, the chairman opened the after proceedings by proposing the toast "Queen and Country," which was honored in usual style. With the next toast, "Steam and Electrical Engineering," were coupled the names of Messrs. Walter Laurie and W. B. Shaw. The toast was honored with gusto and cheers. Mr. Laurie replying on behalf of steam engineering expressed his pleasure at being present. He had attended the first dinner ever given by Montreal No. 1, and had attended several since. Each was an improvement on the preceding ones and kept pace with the general progress in engineering. "My greater reason for accepting the present invitation was knowing that there were to be so many outsiders present, I thought of hearing something of valuable interest and did not expect to be called upon to say anything myself. I can only congratulate you on the progress your association has made. You deserve great credit for the immense strides you have made. I believe those here have those qualities necessary to make competent engineers. Younger men think that when they get into an association they can get such wages as they want. This society is not of that kind, but the members are studying to advance the interests of themselves and their employers alike. Young men are apt to think that so long as their bosses take notice of them they are all right, but the only true way to get along is to render yourselves indispensable to your employers." (Applause).

Mr. Shaw in reply said: "The toast you ask me to reply to is one I should have preferred to have been replied to by some older member of the electrical fraternity, but like the old lady and the pill, the sooner taken the sooner over. To my mind Steam, Hydraulic and Electrical Engineering are like Faith, Hope and Charity. They go hand in hand. To cite a close alliance between them, I might mention the equipment of the Crocker-Wheeler Co.'s factory in New Jersey, where one large engine in the basement is used to drive an electric generator, the power from which is conveyed by means of wires direct to each machine. I mean there is absolutely no shafting or belting. The motors which operate the lathes and other machinery are located in the head-stock and are indirectly coupled, the speed being controlled by a regulator attached to its supports. In this way each machine is under individual control. Higher efficiency is claimed for this over the old method of belting and shafting. Electrical engineering will call for higher efficiency in steam engineering. Mr. Shaw concluded by promising a hearty welcome to any of those present who should attend any of the meetings of the electrical club of which he was honorary president.

The toast "Manufacturing Interests," was next responded to by Mr. Hugh Valance. He thought it was taking advantage of guests to invite them to the banquet to have a good time and then take it out of them in speeches. On several former occasion he had been called upon to deliver addresses and lectures on steam boilers and engineering to the members of the Montreal Association. At first they did not seem to understand what he was talking about, but the last time he had been met with a shower of questions from his audience which clearly proved that they had been educating themselves. Now they were leading engineers. At first they did not seem capable of taking the capacity of an engine and boiler, but now they were capable of doing anything necessary around an engine house. Speaking once to a manufacturer who had an engineer from this association, but who was just then away, this manufacturer confessed that he had been forced in the meantime to employ an incompetent man. This man was burning 300 pounds of coal more and not keeping up steam so well as the absent engineer. There should be a Dominion license law for steam engineers. There was one for marine engineers. A certificate was required to run even the smallest yacht, but any man can take hold of a stationary engine to the imminent danger of human life. He urged the Association to petition the government to enact a license law. Continuing Mr. Valance said, "I agree with Mr. Shaw that electricity will not interfere with steam engineering. I believe that so long as grass grows and water runs steam will be necessary. Engine makers need have no fear of making too many engines or losing their trade. There was a complaint that the western men were building too many cheap engines. Well all I can say is, that if our western friends make cheap engines and cheap boilers we have men here capable of running them." He urged the association to ask the city council of Toronto to appoint one of its members to assist the boiler inspector. There were a great many needless questions asked by the civic board of examiners. All these things are very well to know, but not necessary for the running of an engine. When a man is refused a certificate for not being able to tell the strength of a seam of a boiler it is high time that other examiners be appointed. (Applause).

Mr. Darling expressed himself as surprised that manufacturers did not take more interest in the association. Engineers are and must be better qualified to-day than in former days. The engines were of a higher grade and more skill was required to run them. (Applause).

"Our Sister Associations" brought the first reply from Bro. Wm. Sutton, Toronto No. 1. He said: "I was just making the remark a while ago to my left hand neighbor here, Brother Mitchell, that I was placed in an awkward position. It is the lot of all of us to be sometimes placed in an awkward position. The reason of my making this remark was that on each side of me was stuck a bottle of beer, and as I don't use it, you can see that I was in a very awkward box indeed. I thought the best way out of the scrape was to leave it alone. Well that is just what I am going to do now. I am in an awkward shape with regard to my speech. I will not, like the brothers who have spoken before me, say that I did not expect to be called on to speak. I did expect to be called upon the moment I knew that I was coming to Montreal. With that expectation I went to work to prepare a speech. When I came home I found the ELECTRICAL NEWS lying on the table. I took it up to read it —I generally do so before supper—and happened to see the programme for this convention in that journal. I looked at it, and looked again. I deducted as I thought all the typographical errors and exaggerations and then considered what was left a pretty good programme. I tried my speech but could not think of anything but programme. Well, I said, I will let it go, I can prepare it on the train. I got on the train for Montreal without any speech; I could not fix it. I arrived in Montreal and I had no speech, so I gave it up. I came, here, and what do I find? Why instead of errors and exaggerations in the programme, it has been carried out to the letter, and far exceeds my greatest expectation. With regard to Toronto No. 1, I should be able to make a good speech. When it had been organized about a month I applied for admission and was accepted as a member. Toronto No. 1 had, if you will allow me the expression, "a hard row to hoe." But we were determined to conquer or die, and to-day Toronto No. 1 is recognized in Toronto by our steam users. When they want an engineer upon whom they can rely to earn his wages they apply to our association. They are satisfied to-day that their interest depends on the knowledge and ability of their engineer. Toronto No. 1 is now in a prosperous condition, and I am glad to know that Montreal is in the same if not a better position. The day has come when the manufacturers recognize the importance of the Association. The day must come when we will have a regular engineers' license law. It was in Toronto No. 1 that the idea of the examining board originated. Brother Edkins and myself tried to get the government to give us a compulsory law. They would not do so. The next best thing to do was to get legislation for examination of voluntary applicants. We succeeded in this. At first very few came up for examination; now they go by dozens, (I was going to say hundreds), and we have now certificates hanging up in a number of engine rooms. I would like to see a compulsory law. It would benefit both the engineer and the manufacturer. I believe that the prosperity of our manufacturing enterprises depends largely on their having intelligent engineers. If we could examine the books of failing manufacturers we should find that the great cause springs from the engine room or boiler room. I have reasons for holding this opinion. When you visit a factory and it is necessary to stumble down into a dark cellar to the engine room and find a dirty engineer who, when he has put a few coals on the fire, if he has any time to spare, is required to pile up lumber and rubbish here and there, to assist in packing and boxing, and has no time to do anything about the engine, you will generally find that that manufactory has not been so prosperous as it might have been. I have made these remarks just as they came to me, and if I have not made a good speech it is not my fault. I shall, if I live a hundred years longer, always remember this visit to Montreal. When I go back I shall tell those in Toronto of the great kindness shown me by our friends in this city. I feel fully ten years younger than when I reached here. I thank you for the way you have honored this toast and for the attention with which you have listened to my remarks.

Bro. Mitchell replied on behalf of London No. 5. He said there was nothing for him to say on the general aims of the Association, but as to the London Association he would say that it was progressing well. They were getting new members continually. He thought they would soon have certificates made compulsory. There was a law in most cities that no gunpowder should be kept within a certain distance from the city limits, yet many of the engines were worse than gunpowder.

Brother Green was happy to say a word for Guelph No 6. He was the originator of the Association. He had got seven engineers to consent to join. He had Edkins to come to Guelph, and on the night of the organization they had sixteen instead of seven. Now the number was twenty six. When the examining board was established he was anxious to try for a certificate, but was afraid, being no scholar. However he tried and came off with flying colors with a second-class certificate. He could not find words in which to thank the Montreal brethren for the way they had been treated.

Brother King replied on behalf of Dresden No. 8. This was the first time he had represented any such organization. Dresden started in May last with sixteen members, now they had eighteen.

Brother Pilgrim, Brantford No. 4, said that No. 4 was progressing favorably. They were united but small in numbers.

Brother Thompson, Ottawa No. 7, remarked that after so many speeches nothing was left for him to say. He was happy to be present, and hoped that the time would pass more quickly this year than last, so that they in Ottawa could return the compliment.

Brother Drouin was called up to reply for Montreal No. 2, but not being adept at English he asked Brother York to reply for No. 2. Bro. York believed that Montreal No. 2 had labored under more difficulties than any other association, but it had got from under the burden. It had shaken off its load and was now as strong as any. There was every day evidence of the work it had done.

Brother Edkins in proposing the health of Montreal No. 1, referred to the splendid exhibit of the Association at the Montreal Exhibition as an evidence of theg reat progress made in engineering, and as a proof of the progress of the two Montreal associations. The toast was heartily drunk and Brother Nuttall was the first to respond. He said: Montreal No. 1 was not so prosperous as Brother Edkins had said it was. Ten per cent. of Montreal No. 1 were doing the thinking for the rest. They had a great many know-alls, a great many guess-alls, a few nonentities and a few rationals. Some get sick when meeting night comes round. At least they think they are sick. We have men of large heads, men of light hearts and big ones, men of great mind. Montreal No. 1 was progressive. They were determined to be in as good a position as any association in the country. He had no idea the west could produce such men as they had sent down amongst them. He was not given to flattery. He knew them or had heard of them all, but he was disappointed. They had proved better men than he thought they were. Montreal No 1 had tried their best to make things pleasant for them and hoped to try again before long.

Brother Ryan also in a few well chosen words thanked those present for the way they had honored the toast of the health of Montreal No. 1. The next toast, "License Law and Inspection," was coupled with the name of O. E. Granberg, inspector for the Boiler Inspection and Insurance Co., of Canada, who said in reply that he could not say that he did not think he would be called upon to say something and the chairman had kindly furnished him with a subject. He would touch upon but a few points. In Montreal there was a license law and an inspection law. There was also a provision in the Quebec factory act for inspection of boilers. To illustrate the great futility of this inspection, he had been called upon to examine a boiler for insurance. He was shown a certificate of inspection by boiler inspector. Said he, "I found a steam plant with four boilers connected with but one safety valve, and that on the steam pipe with two stop valves between it and the boiler. The steam guage was on the steam pipe between safety valve and the engine. If a valve should be shut, two boilers would be left without either safety valve or guage. I refused the insurance. The proprietor told me that he had run this machinery for 25 years without any accident. Insurance Companies can always protect themselves in cases of this kind by refusing to take the insurance. I reported this case to the factory inspector but no notice was taken of it. All this goes to show that a license law is as necessary as an inspection law. I am in favor of a Dominion license and inspection act. If engineers would bring all their combined powers to bear on the Dominion authorities, instead of dividing themselves up and trying to influence the Provincial or municipal governments, I believe that they would be able to accomplish something. Some engineers are progressive, and many have asked me where they could get a certificate. Others are backward and incompetent. I think that the manufacturers will soon see the practicability of engaging competent and intelligent engineers. Seen in the right light, they will soon learn that for every dollar saved directly by engaging cheap men, they will save ten dollars indirectly in fuel and plant.

"The Brotherhood of Locomotive Engineers," was responded to by Mr. Fred Lytle, President of that order, Mr. Robert Whitehead, the pioneer engineer in Canada, and by Mr. Thomas Clarke, chief engineer of the Bro. Loc. Engineers., Montreal division. The latter, speaking at some length said: The object of the C. A. S. E. and the B. L. E. was similar; both were educating themselves to get to the highest position in their trades. Their positions however were different. The stationary engineers had only their employers to please, while locomotive engineers must please a number of persons. It was therefore necessary for them to band together to protect themselves. There would be no trouble if they had only one man to deal with as the stationary engineers had. They would not think of forming a labor organization in that case. There were a number, however, who got to the head of railway departments for no other reason than that they owned a large amount of the stock. All these people wanted was a return on that stock, and they did not care where it came from. There never has been a cause of conflict between the locomotive engineers and practical men. It was those who by reason of great inherited wealth had been able to procure control, that had caused all the trouble. Where there were practical men to be dealt with they were generally successful in their demands for their rights. Those who know nothing of the matter but look for the best possible interest on their stock, make the trouble. The locomotive engineers had pledged themselves to make no trouble during the Fair at Chicago. That promise had been faithfully carried out. There has been cause, many causes, but they did not want to sidetrack the public going to and from the fair. They were going to carry out their agreement in this respect until the Fair closed. The Toledo and Ann Arbor road had withdrawn their action against Chief Arthur. The railway dare not take it before the courts of the country. The report that the company had been paid a sum of money to discontinue the action was false. As to electricity it was yet in its infancy. They had yet much to expect from it, but he quite agreed with previous speakers that steam engineers had nothing to fear from it, and they had steam engines that can take passengers over the road as fast as the road would permit them to go. They need have no fear of being out of work during their life time. They had not a road bed capable of sustaining a speed of 100 miles per hour. He had watched the progress of the Canadian Association of Stationery Engineers. They could be trusted with the lives and property of the general public. Steam engineers controlled one of the vastest powers on earth, a power of which no man can conceive the force. He thought they would soon be called upon to pass an examination. Let them study their profession and not allow any inspector to catch them napping, but be ready to explain anything that they might be called upon for. If they made themselves valuable men there would be no trouble about wages. If they (both associations) put their heads together they could obtain legislation that would mutually benefit both stationary and locomotive engineers.

"The " N. A. S. E." was the next toast, and Brother Wickens, as an honorary member of that association, responded. He was glad at any time to respond for the N. A. S. E. It was organized nine years ago in Detroit. It was an educational order like the Canadian Association. It now numbered over 7000 members and was doing a great work for engineers; and it must not be forgotten that it was doing much for employers as well. They were converting employers very fast. Employers were beginning to see that they were working along right lines. They were taking steps to place the handling of steam in safe hands. The matter of the amount of steam used was appalling. The engines in use in the United States and Canada amounted to 8,000,000 horse power; in Great Britain it was 7,000,000 horse power; in Germany, 4,500,000; in France, 3,500,000. This did not include locomotive engines, which on this continent numbered over 70,000. Every one of these engines was a little powder keg if not properly handled. An ordinary five foot boiler had a stored energy equal to 42 pounds of powder. The reported explosions average about 152 yearly: many do not get into the papers. The number of people injured every year amounts to from four to five hundred. The killed reaches two and three hundred annually. All this could be prevented if the proper parties were there to do it. Four-fifths of the engines now in use had been built within the last twenty-five years. This shows the rapid growth of steam engineering. To manage these, men were required. The demand was so great that incompetent men had to be called in to take charge. As engines improved it required men of greater ability to take the management thereof. Nearly all those competent men are members of our associations. He knew of several instances where the salary of engineers had been increased without demand. Referring to license laws, he said the marine engineers had a law, and he wanted to know why the life of a man walking down the street was not as much worth protecting as that of a man crossing the river in a ferry boat. There were thousands of people on the street as well worthy of protection as the forty running the rapids. He thought that if they pushed for it they could get a law. The Americans had been working along the same lines as themselves. All their cities had local license laws, the result of agitation on the part of the associations. Next year they will have eleven States at work on license legislation, and they will surely be successful in some cases. The Americans are exactly like us—we talk alike, look alike, with only a little imaginary line between us. The Americans are willing to help us along. The speaker thanked those present for the manner in which they drank the toast to the N. A. S. E., and thanked them for coupling his name with the association.

The toast of the C. A. S. E. brought President A. E. Edkins to his feet. He said:—In replying to the toast of the Executive Council of the Canadian Association of Stationary Engineers, which has just been proposed, allow me, as President of the executive, to thank you most sincerely for the kindly manner in which you received the same. The work of the executive is to take the general supervision of all subordinate associations and to establish new associations throughout the country, wherever the number of engineers employed may warrant so doing. As I stated in my address at the opening of the convention, the work done by the executive during the past year has been very sucful. It has, possihly, not been so successful as the more enthusiastic of us might wish. I myself, for instance, made up my mind, when the association did me the honor at last convention of placing me in the chair of the executive, to organize at least double the number of associations that we have done this year, but when I made that resolution I did what many have done before me—counted my chickens before they were hatched.

When we take into consideration the small number of men engaged in our profession on which we can draw for our membership, compared with the vast number that other organizations have, it will be evident at once that we can never (or at least for a number of years) expect to have such a large membership as the N. A. S. E., for instance, can boast. Taking all these facts into consideration, I think we can with reason congratulate ourselves on the number of new associations which we have added to our membership during the past term. The Executive has spared no effort in making this year a prosperous one in the history of the Association, and I desire to take this opportunity of returning my sincere thanks to the other Executive officers and the District Deputies, Bros. Ryan, Angell and Mitchell, for the strong support and able assistance which they have given me, and I respectfully solicit a continuance of the same to my successor in office.

The organization of the C. A. S. E. was, in my estimation, a grand thing in the interests of the engineers of this country, and I feel that every practical engineer should come forward and join us, so that we may not only be able to assist him, but also that he may give us the benefit of his experience in our meetings. It is in the hands of the engineers of this country to make their chosen calling rank high in the estimation of the steam users and our fellow citizens, by proving to them that we are men who are endeavoring to raise the standard of our calling to the proper level which it should occupy among the trades of our country. The C. A. S. E. has done more for the engineers in Canada, than most people are aware; it has proved to the public through the reports of its meetings and discussions in the papers, that the stationary engineer of to-day is a much more important person than he was 20 years ago. The sharp competition in all lines of business at the present time requires that manufacturers shall reduce the cost of production of their various lines, to the lowest possible price, and the generation and utilization of steam becomes a most important factor in this direction. They have therefore been compelled to install steam plants and machinery of the most economical and improved type to gain the desired end. Now this is all very good, and is in the proper direction, hut as you all know, these modern high class machines, with their delicate and complicated valve gear and motions soon become as wasteful and expensive as the old class of engine unless the engineer in charge is competent and well up in his business.

The object of this Association is to help to educate its members in the profession of steam engineering, in order to fit them for positions as stationary engineers, and there are not wanting instances in our membership to prove that the association is nobly fulfilling its mission. I am fully convinced, Mr. Chairman, that it would be a hard matter to fully estimate the benefits that have in the past accrued, and will in the future also, to the steam users and the stationary engineers of Canada as a result of the C. A. S. E.

Vice-President Hunt also replied to this toast. The President deserved the thanks of all for the way he had worked.

To "Our Guests," Mr. Samuel Fisher and Mr. W. E Gower made suitable replies, wishing long life and prosperity to the Canadian Association of Stationary Engineers.

"The Press" was briefly responded to by Mr. W. H. Sibly and Mr. F. B. Wilson.

After the health of the Souvenir Committee and experience of the different members in getting through the work, all joined hands and sang "Auld Lang Syne," when the most enjoyable event of the most successful convention of the Canadian Association of Engineers was brought to a close with "God Save the Queen," and cheers for Montreal Nos. 1 and 2.

At intervals during the evening the proceedings were enlivened by musical selections by Bros. Mitchell, Blackgrove and D. Robertson.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of the various Associations are requested to forward us matter for publication in this Department not later than the 20th of each month.

TORONTO NO. 1.

Arrangements are being made for holding open meetings once a month during the autumn and winter. At each of these meetings an address will be given by an experienced engineer on a subject related to steam plant management. The first of these open meetings will take place in October, and will be addressed by Mr. Chas. Heal, his subject being "Heat." At the November meeting Mr. A. M. Wickens will speak on "The Expansion of Steam." These meetings, to which every person interested in steam engineering is invited, will no doubt be productive of much interest, and should be the means of adding many new names to the membership roll of the Association.

LONDON NO. 5.

On the 29th of August the members of the above Association tendered a farewell banquet at the Western Hotel, to their president, Mr. Fred. G. Mitchell, on the eve of his departure from the city to assume the duties of a position with the Boiler Inspection and Insurance Company, of Toronto. Congratulatory speeches were made by Brothers Risler and Taylor, and replied to by the retiring president. An evening of much enjoyment was spent, and Mr. Mitchell carries with him the best wishes of every member of the Association for his future success.

THOMSON VS. ROYAL ELECTRIC CO.

It is reported that Mr. Fred. Thomson has entered an action against the Royal Electric Company, for wrongful dismissal. It is said that Mr. Thomson was working under a five years' agreement with the Company at a fixed salary, and that he will endeavor by legal process to enforce payment of his salary for the full term of the agreement.

As a means of cooling bearings in any place where air-compressors are used, or where an air supply is convenient, it would be well to conduct a pipe so as to blow air upon the heated bearings. Air has an additional advantage in the fact that it cools in expanding so as to still further aid in the cooling of boxes where the scheme is applied.

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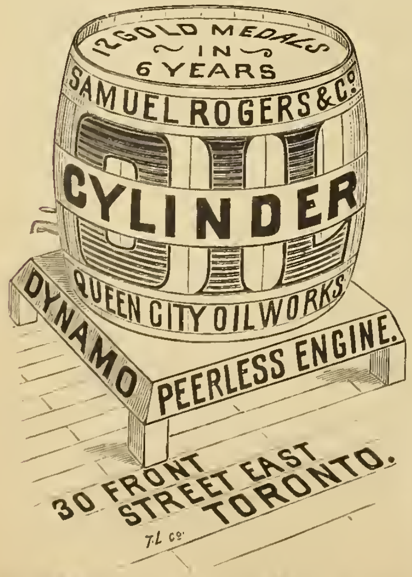

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SPARKS.

The Ottawa City Council has resolved that all teleppone wires must go underground.

Mr. A. E. Sulis has sold his electric lighting plant at Bridgetown, Nova Scotia, to Mr. J. W. Beckwith.

Messrs. Leason & Lineham have been granted a franchise for an electric street railway at Calgary, N. W. T.

Geo. Boswell, of East Toronto, was committed for trial by a local magistrate recently, on the charge of shooting at conductor Percy Lynn, of the Toronto and Scarboro' Railway.

It is reported that the Brush Electric Co. may start a manufactory at St. John, N.B. The names of Mr. G. F. Walker of, St. John, and Col. N. S. Rogers, of Cleveland, are connected with the enterprise.

H. Pim has arrived in Vancouver from Toronto to assume the management of the Canadian General Electric Company, Mr. Maxwell, the former manager, having removed to Portland to manage the Portland branch.

After considerable delay in obtaining the necessary plans for the engine and dynamo foundations, arrangements are now completed for the electric light service to be installed by the Waterworks and Electric Light Co. of Lethbridge, N. W. T.

The Canadian General Electric Company have decided to consolidate the various departments of their manufacturing business at Peterboro'. The Council of that town have granted the Company a bonus of $5,000 as an inducement to carry out this step.

TRADE NOTES.

The Kay Electric Works, of Hamilton, recently installed an arc and incandescent plant for lighting the mills and yards of Messrs. John Smith & Son, of Callender, Ont.

One of the heaviest locomotive freight engines in Canada, is at present under constructian at the Kingston Locomotive Works. The cylinders will be 18 by 26 inches. The engine will be capable of hauling up an ordinary grade 45 loaded cars.

PUBLICATIONS.

A Directory of street railway exhibits at the World's Fair has been compiled and published by the *Street Railway Gazette*, Chicago.

The Penberthy Injector Company, publishers of the "Penberthy Bulletin," intend in future to publish extracts of interest to engineers taken from the leading mechanical journals, and will send a copy of the publication free to any engineer who may write for it.

PERSONAL.

Mr. Warren Y. Soper, of Ottawa, is at present in Paris.

Mr. John Patterson, of the Hamilton, Ont., Radial Electric Railway, was a recent visitor at the World's Fair.

Ald. Wm. Bell has been appointed successor to the late E. A. Wills, as Chief Engineer of Government Buildings at Toronto.

Mr. J. B. Griffith, manager of the Hamilton Electric Railway Company, accompanied by Mrs. Griffith, is at present on a visit to California.

Mr. F. W. Martin, who has been for some years with the Toronto Electric Light Company, has been appointed manager of the Hamilton Electric Light and Power Company.

Mr. Dan. Thomson, late manager of the Hamilton Electric Light and Power Company, was recently made the recipient of a handsome silver fish and carving set, together with several articles of silver and a sealskin purse for Mrs. Thomson. The presentation was made by Mr. Robert Dickinson, chief engineer, on behalf of the employees of the Company.

Mr. Alex. Taylor, of the Edmonton, N. W. T., Electric Light Co., recently spent a couple of weeks in Eastern Canada with the purpose of purchasing the necessary machinery for greatly increasing the capacity of the Company's plant. Mr. Taylor has been a resident of Edmonton for the last fifteen years, and this is the first time that he has visited the eastern provinces during that period. He came just in time to participate in the C. E. A. convention.

OBITUARY.

It is with much regret that we announce the death of Mr. J.A. Angell, President of the Guelph C. A. S. E. Mr. Angell had just returned from the convention at Montreal when death overtook him. During his stay in Montreal, he was too unwell to take as a part as he would have desired in the proceedings of the convention. His brethren did all they could for his comfort while in Montreal and on the return trip as far as Toronto, where they saw him safely on board the train for his home at Guelph. The deceased had been in poor health for a couple of years, and in making the journey to Montreal, he no doubt overtaxed his strength. With the exception of a couple of years spent on the Grand Trunk Railway, Mr. Angell was employed during the twenty years of his residence in Canada, as Chief Engineer at the Agricultural College at Guelph. He was a good mechanic and engineer, and an enthusiastic worker in the C. A. S. E., of which he was District Deputy and Executive President for Guelph.

The municipality of London West has granted a franchise to Col, Clark, representing a Detroit Syndicate, for the construction of an electric railway.

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	H.M.	H.M.	H.M.
1	P. M. 6.10	P. M. 10.40	4.30
2	" 6.10	" 11 50	5.40
3	" 6.10	A. M. 12.50	6.40
4	" 6.10	" 1.00	6.50
5	" 6.10	" 2.10	8.00
6	" 6.10	" 3.20	9.10
7	" 6.00	" 4.30	10.30
8	" 6.00	" 5.00	11.00
9	" 6.00	" 5.10	11.10
10	" 6.00	" 5.10	11.10
11	" 6.00	" 5.10	11.10
12	" 6.00	" 5.10	11.10
13	" 6.20	" 5.10	10.50
14	" 7.00	" 5.10	10.10
15	" 7.40	" 5.10	9.30
16	" 8.40	" 5.10	8.30
17	" 9.40	" 5.10	7.30
18	" 10.40	" 5.10	6.30
19	" 11.00	" 5.10	6.10
20	" 11.50	....	5.30
21	....	" 5.20	
22	A. M. 12.50	" 5.20	4.30
23	" 1.50	" 5.20	3.30
24	" 3.00	" 5.20	2.20
25	No light.	No light.	....
26	No light.	No light.	....
27	P. M. 5.30	P. M. 7.40	2.10
28	" 5.30	" 8.40	3.10
29	" 5.30	" 9.40	4.10
30	" 5.30	" 10.50	5.20
31	" 5.30	" 11.50	6.20
		Total,	203.10

SPARKS.

The General Electric Company's new power station at London is nearly completed.

The electric light plant at Wiarton, Ont., was destroyed by fire on the 5th of September.

The Brandon Electric Light Company invite tenders until the 10th of October for $20,000 of bonds.

It is said that the construction of the electric railway from St. Catherines to Port Dalhousie, will not be commenced until the spring.

The Toronto Screet Railway Company have decided to try the experiment for one month of carrying the city's street refuse to Ashbridge's Bay.

Mr. C. W. Hutchings has been appointed as city inspector of electric wiring for the city of Vancouver. The board of underwriters of that city have adopted the rules of the Pacific Coast Board of Underwriters.

Mr. A. A. Wright who lately put in operation an incadescent plant at Renfrew, Ont., is to have a competitor in a new company which has since been formed, and of which Mr. Mackay is one of the leading promoters.

The council of the village of Grimsby have refused assistance to the Hamilton, Grimsby and Beamsville Electric Railway Company, on the ground that the road would be the means of diverting trade from the village to Hamilton.

A project is on foot for the construction of an electric railway from Brantford, via the Indian reserve, Hagarsville, Nelles Corners and Balmoral, to Selkirk, situated on Lake Erie, a distance of 30 miles, with the object of making Selkirk a summer resort. It is believed that in addition to a passenger traffic, the line would carry considerable freight.

The Bell Telephone Company's system at Brandon, Man., is being thoroughly overhauled and repaired under the superintendance of Mr. Frank Walsh, manager, and Mr. Mitchell, superintendent of construction, of the Winnipeg exchange. The systems at Regina and Wheat City have also been repaired, and at Moose Jaw an entirely new exchange has been put in. In Winnipeg, Mr. Walsh and his assistants are busily engaged in constructing a metallic circuit.

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SPARKS.

The electric street railway service has been put in operation in Kingston.

It is the intention of the Brantford Electric Power Company to erect a new dam on the Grand River.

The employees of the Ottawa mica miners held a very enjoyable picnic near buckingham, Que., on the 26th of August.

Mayor Dagg and R. B. Cumming, of Selkirk, Man., were in Toronto recently endeavouring to make arrangements for the construction of an electric railway between the City of Winnipeg and Selkirk, a distance of 20 miles. A charter has already been obtained.

The City Council of Ottawa have had under consideration for some time the question of the advisability of the city owning and operating its own lighting plant, and have apparently come to the conclusion that the lighting should be done in this manner. The sole control of the water power of the Ottawa River rests with the Dominion Government. The Government have entered into leases with a number of companies for the use of the water for power purposes, reserving the right for the city to take such water as it may require for waterworks purposes only. A committee of the council has been appointed to interview the Government and endeavor to secure for the city the right to water for power purposes also, and learn the terms upon which it may be obtained; to secure if possible a suitable site for utilizing such power, and report upon the cost, to report as to whether the city has power to purchase or expropriate a site outside the city limits and issue debentures for payment of same; whether a suitable site and power privileges can be purchased within the city, and at what cost; and whether a steam plant as an auxiliary to the water power would be required.

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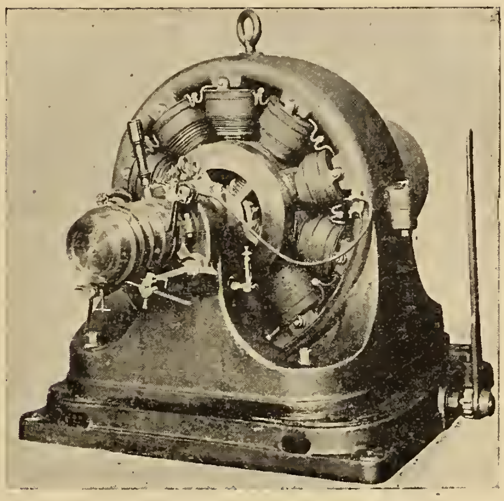

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The Bell Telephone Company have removed to new and commodious offices in the Dunham Block at Brockville, Ont.

The Gaynor Electric Fire Alarm Company, of Louisville, Ky., are looking for a suitable location for a branch of their business in Canada.

Mr. Dingman, manager of the Toronto & Scarboro' Electric Railway, proposes to inaugurate a trolley freight service on the Kingston road.

Mr. Graham of the Electric Wire and Fixings Company, Westminster, B. C., has devised apparatus by the use of which telephones can be made to deliver messages audibly.

Mr. D. H. Keeley, acting Superintendent of Government Telegraphs, Ottawa, represented that department at the International Electrical Congress held at Chicago recently. The Department of Inland Revenue was also represented by Mr. O. Higman.

The Niagara Falls Park and River Railway Company are offering for sale at par, $300,000 of stock, the intention being to duplicate the line owing to the unexpected passenger business which has been encountered during the first season of the operation of the road.

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[This belt has been in constant use since August, 1885, and looks good for another ten years yet.] Also
One 36 inch belt 100 feet long. One 38 inch belt 100 feet long.
One 36 inch belt 123 feet long. One 24 inch belt 100 feet long.
And over 1500 feet of 8 inch belting.
All the above belts are DOUBLE THICKNESS and are all giving satisfaction.
The 38 inch belt is the largest belt ever made in this Province.

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The Berlin Electric and Gas Co.
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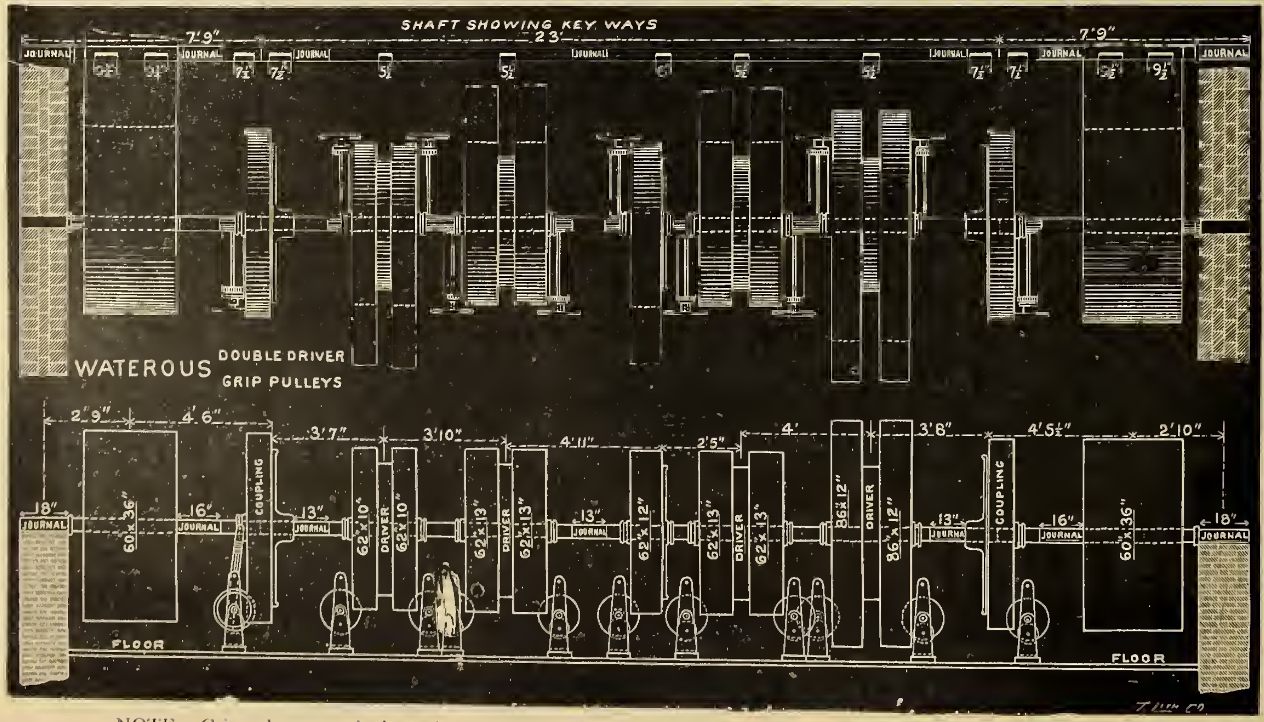

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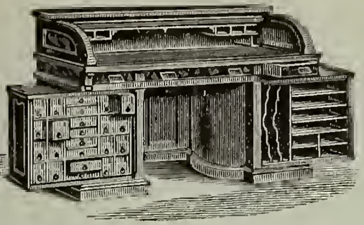

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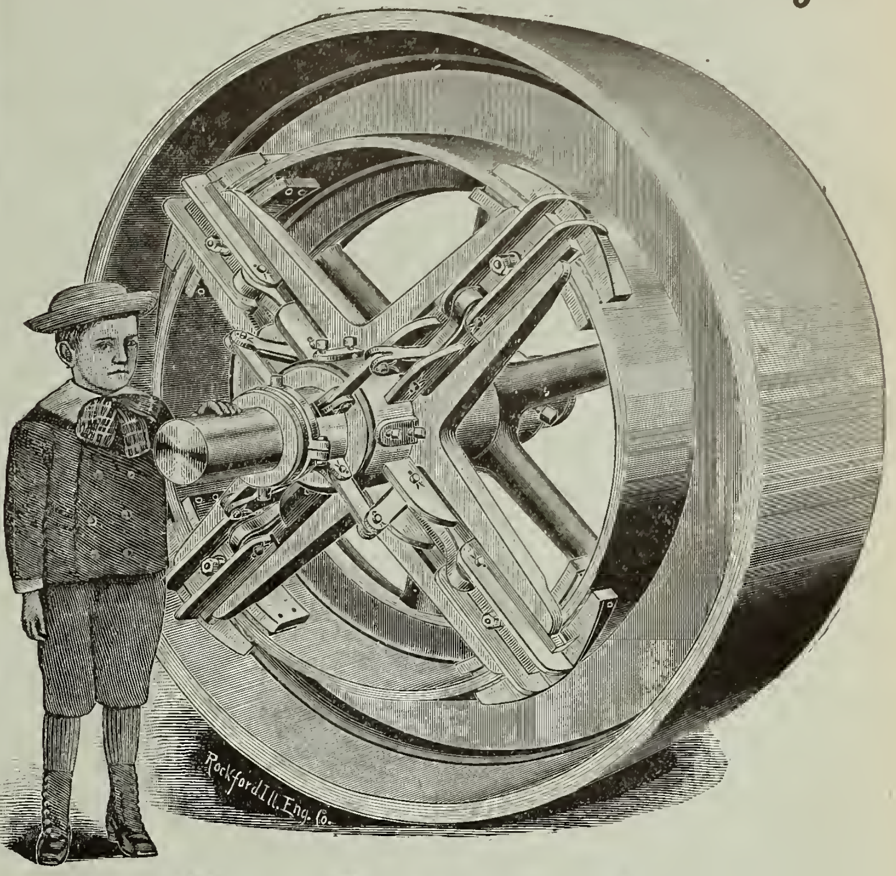
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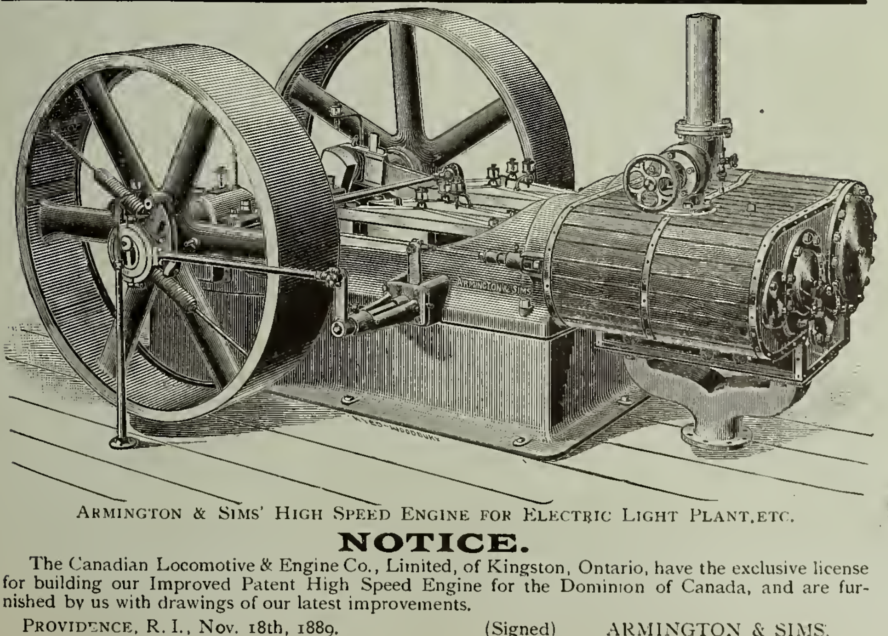

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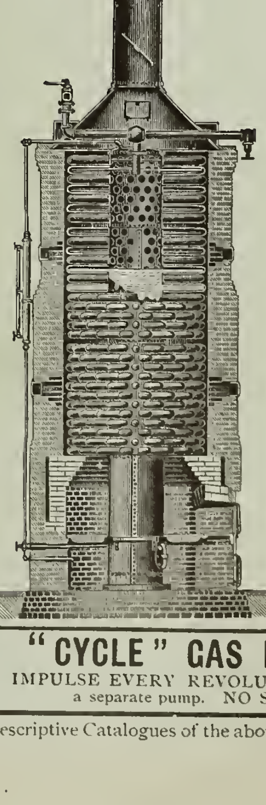

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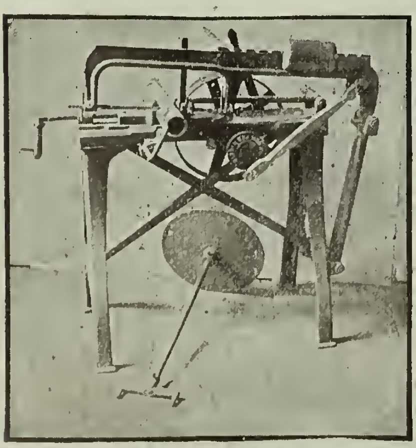

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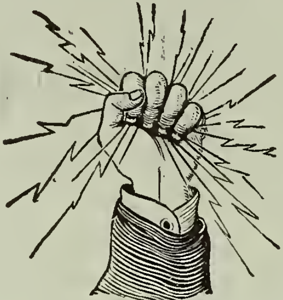

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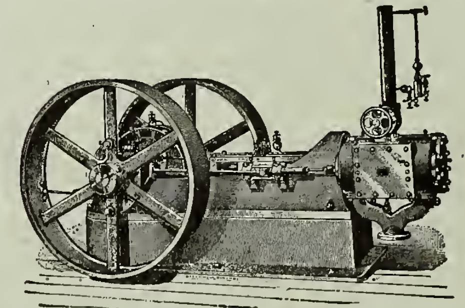

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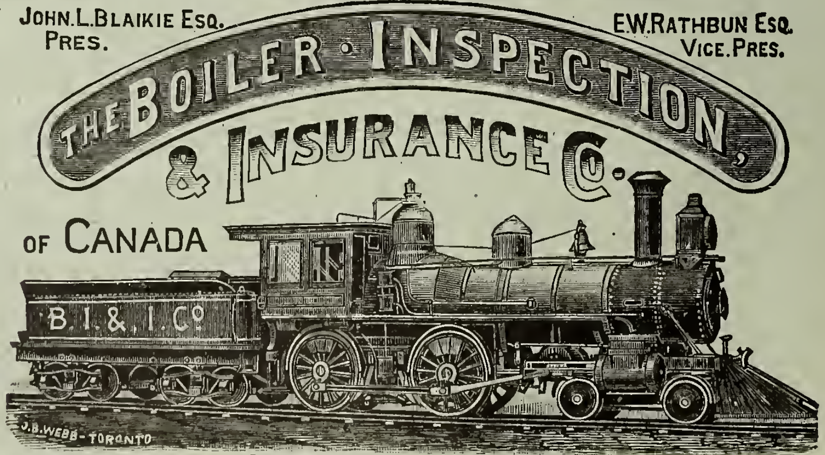

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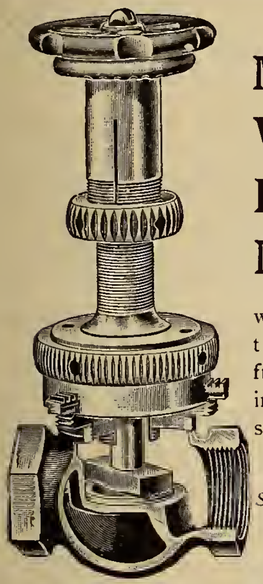

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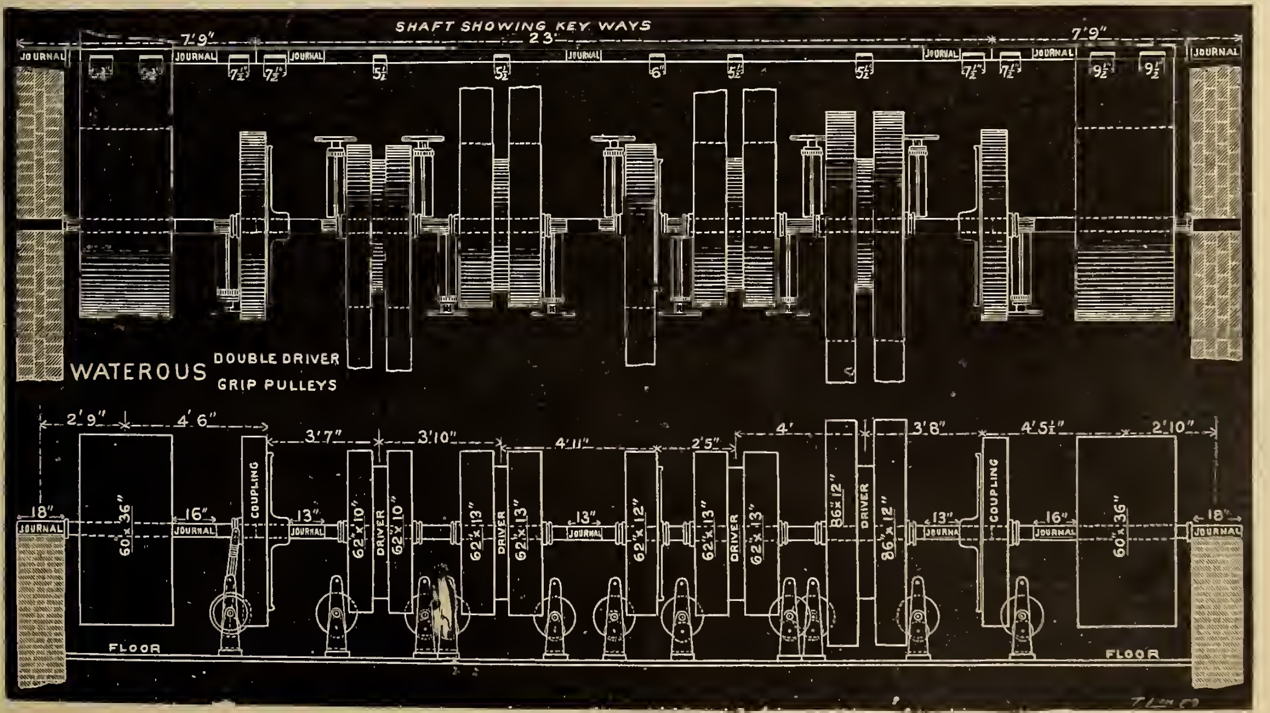

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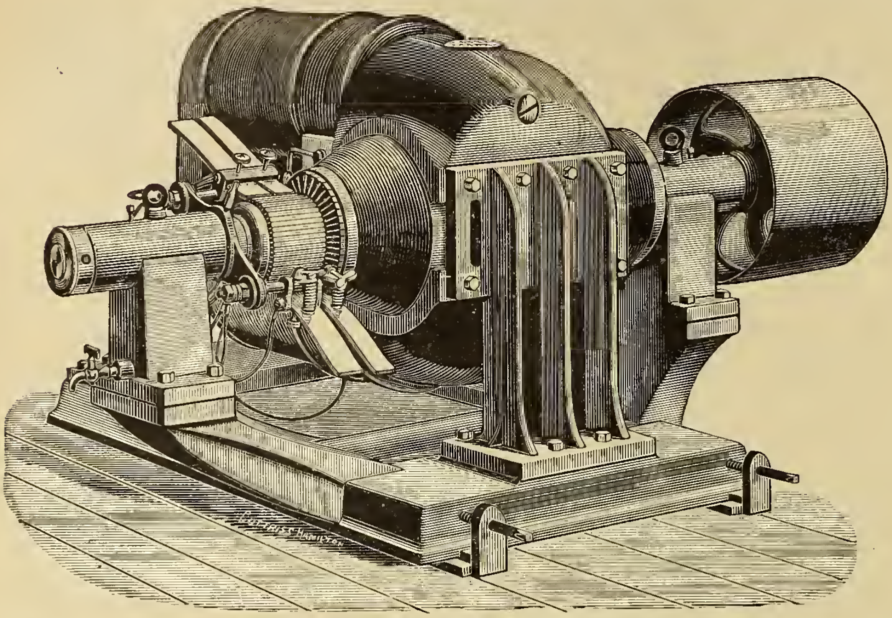

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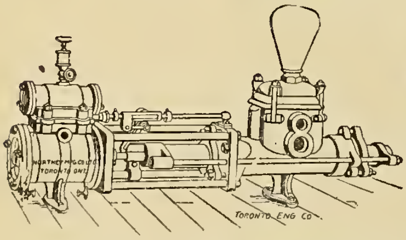

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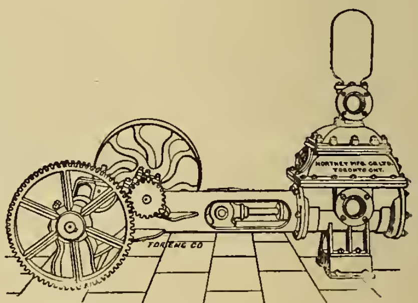
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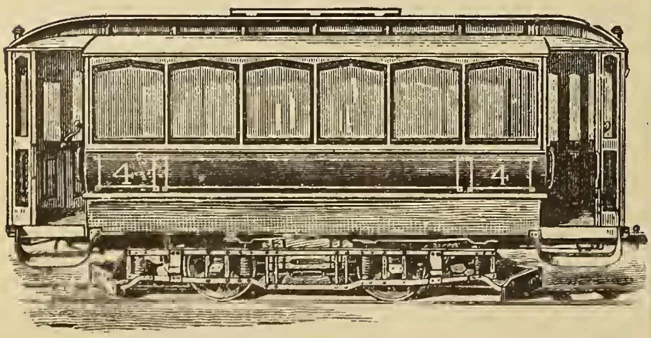

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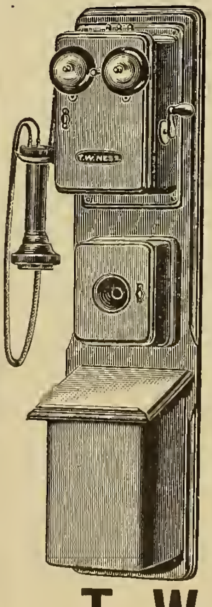

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VOL. III. NOVEMBER, 1893 NO. 11.

ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.

By NIKOLA TESLA.

(Continued from September Number.)

A form of such discharger with a magnet which has been found convenient, and adopted after some trials, in the conversion of direct currents particularly, is illustrated in Fig. 2. N S are the pole pieces of a very strong magnet which is excited by a coil C. The pole pieces are slotted for adjustment and can be fastened in any position by screws s^1 s^1. The discharge rods d^1 thinned down on the ends in order to allow a closer approach of the magnetic pole pieces, pass through the columns of brass $b\ b^1$ and are fastened in position by screws s^2 s^2. Springs $r\ r^1$ and collars $c\ c^1$ are slipped on the rods, the latter serving to set the points of the rods at a certain suitable distance by means of screws s3 s3, and the former to draw the points apart. When it is desired to start the arc, one of the hard rubber handles h h^1 is tapped quickly with the hand, whereby the points of the rods are brought in contact, but are instantly separated by the springs $r\ r_1$. Such an arrangement has been found to be often necessary, namely in cases when the E. M. F. was not large enough to cause the discharge to break through the gap, and also when it was desirable to avoid short circuiting of the generator by the metallic contact of the rods. The rapidity of the interruptions of the currrent with a magnet depends on the intensity of the magnetic field and on the potential difference at the ends of the arc. The interruptions are generally in such quick succession as to produce a musical sound. Years ago it was observed that when a powerful induction coil is discharged between the poles of a strong magnet the discharge produced a loud noise not unlike a small pistol shot. It was vaguely stated that the spark was intensified by the presence of the magnetic field. It is now clear that the discharge current, flowing for some time, was interrupted a great number of times by the magnet, thus producing the sound. The phenomenon is especially marked when the field circuit of a large magnet or dynamo is broken in a powerful magnetic field.

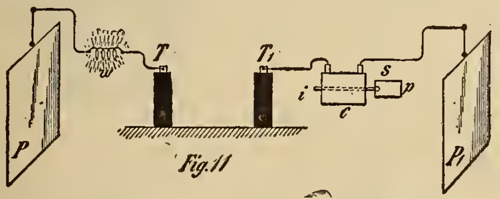

Fig. 11

SHOWING EFFECTS OF CURRENTS FLOWING THROUGH OPEN CIRCUITS.

When the current through the gap is comparatively large, it is of advantage to slip on the points of the discharge rods pieces of very hard carbon and let the arc play between the carbon pieces. This preserves the rods and besides has the advantage of keeping the air space hotter, as the heat is not conducted away as quickly through the carbons, and the result is that a smaller E. M. F. in the arc gap is required to maintain a succession of discharges.

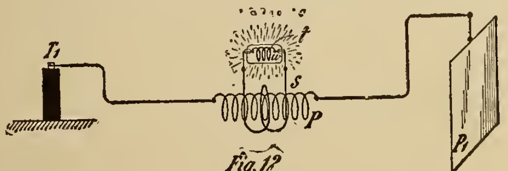

Fig. 12

CONVERSION ON OPEN CIRCUIT WITH COAL AND INSULATED PLATE.

Another form of discharger which may be employed with advantage in some cases is illustrated in Fig. 3. In this form the discharge rods $d\ d^1$ pass through perforations in a wooden box B, which is thickly coated with mica on the inside, as indicated by the heavy lines. The perforations are provided with mica tubes $m\ m_1$ of some thickness, which are preferably not in contact with the rods $d\ d_1$. The box has a cover C which is a little larger and descends on the outside of the box. The spark gap is warmed by a small lamp l contained in the box. A plate p above the lamp allows the draught to pass only through the chimney c of the lamp, the air entering through holes o o in or near the bottom of the box and following the path indicated by the arrows. When the discharger is in operation the door of the box is closed so that the light of the arc is not visible outside. It is desirable to exclude the light as perfectly as possible, as it interferes with some experiments. This form of discharger is simple and very effective when properly manipulated. The air being warmed to a certain temperature has its insulating power impaired, it becomes dielectrically weak, as it were, and the consequence is that the arc can be established at much greater distance. The air should, of course, be sufficiently insulating to allow the discharge to pass through the gap disruptively. The arc formed, under such conditions, when long, may be made extremely sensitive, and the weak draught through the lamp chimney c is quite sufficient to produce rapid interruptions. The adjustment is made by regulating the temperature and velocity of the draught. Instead of using a lamp it answers the purpose to provide for a draught of warm air in other ways. A very simple way which has been practised is to inclose the arc in a long vertical tube with plates on the top and bottom for regulating the temperature and velocity of the air current. Some provision had to be made for deading the sound.

The air may be rendered dielectrically weak also by rarefaction. Dischargers of this kind have likewise been used by me in connection with the magnet. A large tube is for this purpose provided with heavy electrodes of carbon or metal between which the discharge is made to pass, the tube being placed in a powerful magnetic field. The exhaustion of the tube is carried to a point at which the discharge breaks through easily, but the pressure should be more than 75 millimetres, at which the ordinary thread discharge occurs. In another form of discharger, combining the features before mentioned, the discharge was made to pass between two adjustable magnetic pole pieces, the space between them being kept at an elevated temperature.

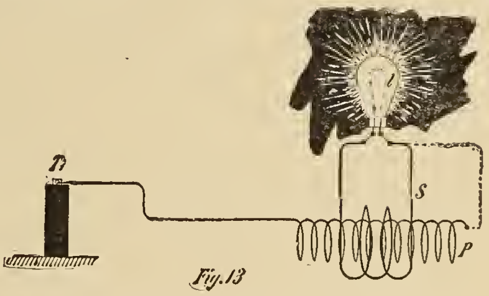

Fig. 13

CONVERSION ON OPEN CIRCUIT WITH COIL ALONE.

It should be remarked here that when such, or interrupting devices of any kind, are used and the currents are passed through the primary of a disruptive discharge coil, it is not as a rule, of advantage to produce a number of interruptions of the current per second greater than the natural frequency of vibration of the dynamo supply circuit, which is ordinarily small. It should also be pointed out here, that while the devices mentioned in connection with the disruptive discharge are advantageous under certain conditions, they may be sometimes a source of trouble, as they produce intermittences and other irregularities in the vibration which it would be very desirable to overcome.

There is, I regret to say, in this beautiful method of conversion a defect, which fortunately is not vital, and which I have been gradually overcoming. I will best call attention to this defect and indicate a fruitful line of work by comparing the electrical process with its mechanical analogue. The process may be illustrated in this manner. Imagine a tank with a wide opening at the bottom, which is kept closed by spring pressure, but so that it snaps off suddenly when the liquid in the tank has reached a certain height. Let the fluid be supplied to the tank by means of a pipe feeding at a certain rate. When the critical height of the liquid is reached, the spring gives way and the bottom of the tank drops out. Instantly the liquid falls through the wide opening, and the spring, reasserting itself, closes the bottom again. The tank is now filled, and after a certain time interval, the same process is repeated. It is clear, that if the pipe feeds the fluid quicker than the bottom outlet is capable of letting it pass through, the bottom will remain off and the tank will still overflow. If the rates of supply are exactly equal, then the bottom lid will remain partially open and no vibration of the same and of the liquid column will generally occur, though it might, if started by some means. But if the inlet pipe does not feed the fluid fast enough for the outlet, then there will be always vibration? Again, in such cases, each time the bottom flaps up or down the spring and the liquid column, if the pliability of the spring and the inertia of the moving parts are properly chosen, will perform independent vibrations. In this analogue the fluid may be likened to electricity or electrical energy, the tank to the condenser, the spring to the dielectric and the pipe to the conductor through which electricity is supplied to the condenser. To make this analogy quite complete it is necessary to make the assumption that the bottom, each time it gives way, is knocked violently against a non-elastic stop, this impact involving some loss of energy, and that, besides, some dissipation of energy results, due to frictional losses. In the preceding analogue the liquid is supposed to be under a steady pressure. If the pressure of the fluid be assumed to vary rythmically, this may be taken as corresponding to the case of an alternating current. The process is then not quite as simple to consider, but the action is the same in principle.

It is desirable, in order to maintain the vibration economically to reduce the impact and frictional losses as much as possible. As regards the latter, which in the electrical analogue correspond to the losses due to the resistance of the circuits, it is impossible to obviate them entirely, but they can be reduced to a minimum by a proper selection of the dimensions of the circuits and by the employment of thin conductors in the form of strands. But the loss of energy caused by the first breaking through of the dielectric—which in the above example corresponds to the violent knock of the bottom against the inelastic stop—would be more important to overcome. At the moment of the breaking through, the air space has a very high resistance, which is probably reduced to a very small value when the current has reached some strength, and the space is brought to a high temperature. It would materially diminish the loss of energy if the space were always kept at an extremely high temperature, but then there would be no disruptive break. By warming the space moderately by means of a lamp or otherwise the economy as far as the arc is concerned is sensibly increased. But the magnet or other interrupting device does not diminish the loss in the arc. Likewise, a jet of air only facilitates the carrying off of the energy. Air, or a gas in general, behaves curiously in this respect. When two bodies, charged to a very high potential, discharge disruptively through an air space, any amount of energy may be carried off by the air. This energy is evidently dissipated by bodily carriers, in impact and collisional losses of the molecules. The exchange of the moleculee in the space occurs with inconceivable rapidity. A powerful discharge taking place between two electrodes, they may remain entirely cool, yet the loss in the air may represent any amount of energy. It is perfectly practicable with very great potential differences in the gap, to dissipate several horse power in the arc of the discharge without even noticing a small increase in the temperature of the electrodes. All the frictional losses occur then practically in the air. If the exchange of the air molecules is prevented, as by inclosing the air hermetically, the gas inside of the vessel is brought quickly to a high temperature, even with a very small discharge. It is difficult to estimate how much of the energy is lost in sound waves audible or not, in a powerful discharge. When the currents through the gap are large, the electrodes may become rapidly heated, but this is not a reliable measure of the energy wasted in the arc, as the loss through the gap itself may be comparatively small. The air or a gas in general is, at ordinary pressures at least, clearly not the best medium through which a disruptive discharge should occur. Air or other gas under great pressure is of course a much more suitable medium for the discharge gap. I have carried on long-continued experiments in this direction, unfortunately less practicable on account of the difficulties and expense in getting air under great pressure. But even if the medium in the discharge space is solid or liquid, still the same losses take place, though they are generally smaller, for just as soon as the arc is established the solid or liquid is volatilized. Indeed, there is no body known which would not be disintegrated by the arc, and it is an open question among scientific men whether an arc discharge could occur at all in the air itself without the particles of the electrodes being torn off. When the current through the gap is very small and the arc very long, I believe that a relatively considerable amount of heat is taken up in the disintegration of the electrodes, which partially on this account may remain quite cold.

The ideal medium for a discharge gap should only crack, and the ideal electrode should be of some material which cannot be disintegrated. With small currents through the gap it is best to employ aluminum, but not when the currents are large. The disruptive break in the air, or more or less in an ordinary medium, is not of the nature of a crack, but it is rather comparable to the piercing of innumerable bullets through a mass offering great frictional resistance to the motion of the bullets, this involving considerable loss of energy. A medium which would merely crack when strained electrostatically—and this possibly might be the case with a perfect vacuum, that is, pure ether—would involve a very small loss in the gap, so small as to be entirely negligible, at least theoretically, because a crack may be produced by an infinitely small displacement. In exhausting an oblong bulb provided with two aluminum terminals with the greatest care I have succeeded in producing such a vacuum that the secondary discharge of a disruptive discharge coil would break disruptively through the bulb in the form of fine spark streams. The curious point was that the discharge would completely ignore the terminals and start far behind the two aluminum plates which serve as electrodes. This extraordinarily high vacuum could only be maintained for a very short while. To return to the ideal medium, think for the sake of illustration, of a piece of glass or similar body clamped in a vise, and the latter tightened more and more. At a certain point a minute increase of the pressure will cause the glass to crack. The loss of energy involved in splitting the glass may be practically nothing, for though the force is great the displacement need be but extremely small. Now, imagine that the glass would possess the property of closing again perfectly the crack upon a minute diminution of the pressure. This is the way the dielectric in the discharge space should behave. But inasmuch as there would be always some loss in the gap the medium which should be continuous should exchange through the gap at a rapid rate. In the preceding example, the glass being perfectly closed, it would mean that the dielectric in the discharge space possesses a great insulating power; the glass being cracked, would signify that the medium in the space is a good conductor. The dielectric should vary enormously in resistance by minute variations of the E. M. F. across the discharge space. This condition is attained, but in an extremely imperfect manner, by warming the air space to a certain critical temperature, dependent on the E. M. F. across the gap, or by otherwise impairing the insulating power of the air. But as a matter of fact the air does never break down disruptively, if this term be rigorously interpreted, for before the sudden rush of the current occurs, there is always a weak current preceding it, which rises first gradually and then with comparative suddenness. That is the reason why the rate of change is very much greater when glass, for instance, is broken through, than when the break takes place through an air space of equivalent dielectric strength. As a medium for the discharge space a solid, or even a liquid would be preferable therefore. It is somewhat difficult to conceive of a solid body which would possess the property of closing instantly after it had been cracked. But a liquid, especially under great pressure, behaves practically like a solid, while it possesses the property of closing the crack. Hence it was thought that a liquid insulator might be more suitable as a dielectric than air. Following out this idea, a number of different forms of dischargers, in which a variety of such insulators, sometimes under great pressure, were employed, have been experimented upon. It is thought sufficient to dwell in a few words upon one of the forms experimented upon. One of these dischargers is illustrated in Figs. 4a and 4b.

A hollow metal pulley P (Fig. 4a), was fastened upon an arbor a, which by suitable means was rotated at a considerable speed. In the inside of the pulley, but disconnected from the same, was supported a thin disc h^1 (which is shown thick for the sake of clearness), of hard rubber, in which there were embedded two metal segments s s with metallic extensions e e into which were screwed conducting terminals t t covered with thick tubes of

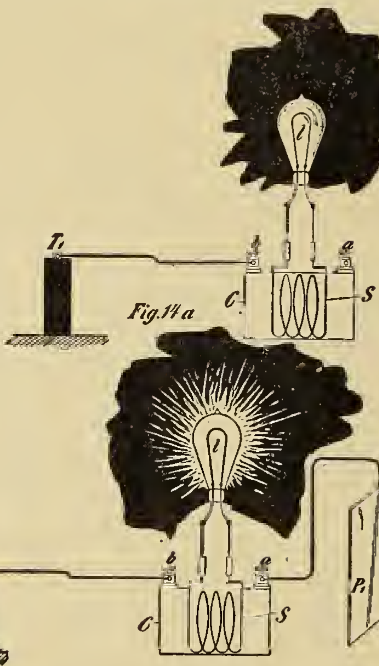

Fig. 14a

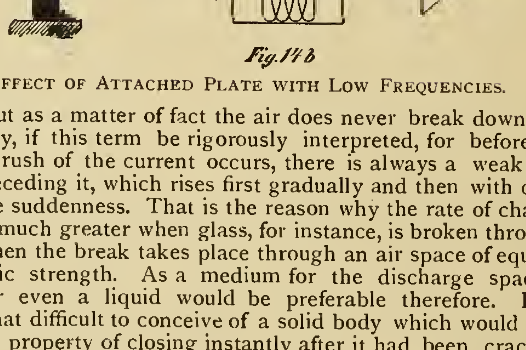

Fig. 14b

EFFECT OF ATTACHED PLATE WITH LOW FREQUENCIES.

hard rubber t t. The rubber disc h, with its metallic segments S S, was finished in a lathe, and its entire surface highly polished so as to offer the smallest possible frictional resistance to the motion through a fluid. In the hollow of the pulley an insulating liquid such as a thin oil was poured so as to reach very nearly to the opening left in the flange f, which was screwed tightly on the front side of the pulley. The terminals t t were connected to the opposite coatings of a battery of condensers so that the discharge occurred through the liquid. When the pulley was rotated the liquid was forced against the rim of the pulley and considerable fluid pressure resulted. In this simple way the discharge gap was filled with a medium which behaved practically like a solid, which possessed the quality of closing instantly upon the occurrence of the break, and which moreover was circulating through the gap at a rapid rate. Very powerful effects were produced by dischargers of this kind with liquid interrupters, of which a number of different forms were made. It was found that, as expected, a longer spark for a given length of wire was obtainable in this way than by using air as an interrupting device. Generally the speed, and therefore also the fluid pressure, was limited by reason of the fluid friction, in the form of a discharger described, but the practically obtainable speed was more than sufficient to produce a number of breaks suitable for the circuits ordinarily used. In Some instances the metal pulley P was provided with a few projections inwardly, and a definite number of breaks was then produced which could be computed from the speed of rotation of the pulley. Experiments were also carried on with liquids of different insulating power with the view of reducing the loss in the arc. When an insulating liquid is moderately warmed the loss in the arc is diminished.

A point of some importance was noted in experiments with various discharges of this kind. It was found, for instance, that whereas the conditions maintained in these forms were favorable for the production of a great spark length, the currents so obtained were not best suited to the production of light effects. Experience undoubtedly has shown that for such purposes a harmonic rise and fall of the potential is preferable. Be it that a solid is rendered incandescent, or phosphorescent, or be it that energy is transmitted by condenser coating through the glass, it is quite certain that a harmonically rising and falling potential produces less destructive action, and that the vacuum is more permanently maintained. This would be easily explained if it were ascertained that the process going on in an exhausted vessel is of an electrolytic nature.

In the diagrammatical sketch, Fig 1, which has been already referred to, the cases which are most likely to be met with in practice are illustrated. One has at his disposal either direct or or alternating currents from a supply station. It is convenient for an experimenter in an isolated laboratory to employ a machine G, such as illustrated, capable of giving both kinds of currents. In such case it is also preferable to use a machine with multiple circuits as in many experiments it is useful and convenient to have at one's disposal currents of different phases. In the sketch, D represents the direct and A the alternating current. In each of these three branch circuits are shown, all of which are provided with double lines switches s s s s s s. Consider first the direct current conversion ; 1a represents the simplest case. If the E. M. F. of the generator is sufficient to break through a small air space, at least when the latter is warmed or otherwise rendered purely insulating, there is no difficulty in maintaining a vibration with fair economy by judicious adjustment of the capacity, self-induction and resistance of the circuit L containing the devices 1 1 m. The magnet N S can be in this case advantageously combined with the air space. The discharger d d with the magnet may be placed either way, as indicated by the full or by the dotted lines. The circuit 1a with the connections and devices is supposed to possess dimensions such as are suitable for the maintenance of a vibration. But usually the E. M. F. on the circuit or branch 1a will be something like 100 volts or so, and in this case it is not sufficient to break through the gap. Many different means may be used to remedy this by raising the E. M. F. across the gap. The simplest is probably to insert a large self-induction coil in series with the circuit L. When the arc is established, as by the discharger illustrated in Fig. 2, the magnet blows the arc out the instant it is formed. Now the extra current of the break, being of high E. M. F. breaks through the gap, and a path of low resistance for the dynamo current being again provided, there is a sudden rush of the current from the dynamo upon the weakening or subsidence of the extra current. This process is repeated in rapid succession, and in this manner I have maintained oscillation with as low as 50 volts, or even less, across the gap. But conversion on this plan is not to be recommended on account of the too heavy currents through the gap and consequent heating of the electrodes ; besides, the frequencies obtained in this way are low, owing to the high self-induction necessarily associated with the circuit. It is very desirable to have the E. M. F. as high as possible, first, in order to increase the economy of the conversion, and, secondly, to obtain high frequencies. The difference of potential in this electric oscillation is, of course, the equivalent of the stretching force in the mechanical vibration of the spring. To obtain very rapid vibration in a circuit of some inertia a great stretching force or difference of potential is necessary. Incidentally, when the E. M. F. is very great, the condenser which is usually employed in connection with the circuit need have but a small capacity, and many other advantages are gained. With a view of raising the E. M. F. to a many times greater value than obtainable from ordinary distribution circuits a rotating transformer g is used, as indicated in Fig. 2a, or else a separate high potential machine is driven by means of a motor operated from the generator G. The latter plan is in fact preferable, as changes are easier made. The connections from the high tension winding are quite similar to those in branch 1a with the exception that a condenser C, which should be adjustable, is connected to the high tension circuit. Usually, also, an adjustable self-induction coil in series with the circuit has been employed in these experiments. When the tension of the currents is very high the magnet ordinarily used in connection with the discharger is of comparatively small value, as it is quite easy to adjust the dimensions of the circuit so that oscillation is maintained. The employment of a steady E. M. F. in the high frequency conversion affords some advantages over the employment of alternating E. M. F., as the adjustments are much simpler and the action can be easier controlled. But unfortunately one is limited by the obtainable potential difference. The windings also break down easily in consequence of the sparks which form between the sections of the armature or commutator when a vigorous oscillation takes place. Besides, these transformers are expensive to build. It has been found by experience that it is best to follow the plan illustrated in Fig. 3a. In this arrangement a rotating transformer g is employed to convert the low tension direct currents into low frequency alternating currents, preferably also of small tension. The tension of the currents is then raised in a stationary transformer T. The secondary S of this transformer is connected to an adjustable condenser C which discharges through the gap or discharger d d, placed in either of the ways indicated through the primary P of a disruptive discharge coil, the high frequency currents being obtained from the secondary S of this coil, as described on previous occasions. This will undoubtedly be found the cheapest and most convenient way of converting direct currents.

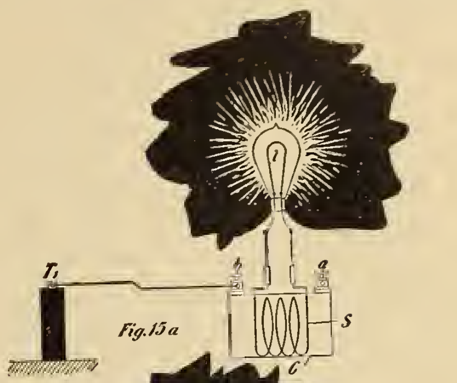

Fig. 15a

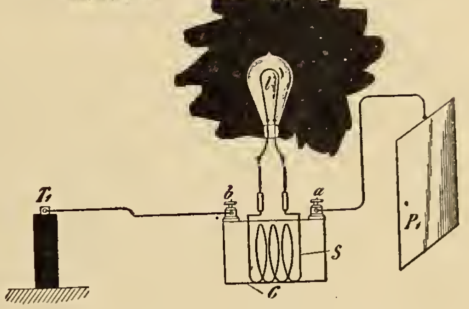

Fig. 15b

Effect of Attached Plate with High Frequencies.

The three branches of the circuit A represent the usual cases met in practice when alternating currents are converted. In Fig. 1b a condenser C, generally of large capacity, is connected to the circuit L containing the devices 1 1, m m. The devices m m are supposed to be of high self-induction so as to bring the frequency of the circuit more or less to that of the dynamo. In this instance the discharger d d should best have a number of makes and breaks per second equal to twice the frequency of the dynamo. If not so, then it should have at least a number equal to a multiple or even fraction of the dynamo frequency. It should be observed, referring to 1b, that the conversion to a high potential is also effected when the discharger d d, which is shown in the sketch, is omitted. But the effects which are produced by currents which rise instantly to high values, as in a disruptive discharge, are entirely different from those produced by dynamo currents which rise and fall harmonically. So, for instance, there might be in a given case a number of makes and breaks at d d equal to just twice the frequency of the dynamo, or, in other words, there may be the same number of fundamental oscillations as would be produced without the discharge gap, and there might even not be any quicker superimposed vibration ; yet the differences of potential at the various points of the circuit, the impedance and other phenomena, dependent upon the rate of change will bear no similarity in the two cases. Thus when working with currents discharging disruptively, the element chiefly to be considered is not the frequency, as a student might be apt to believe, but the rate of change per unit of time. With low frequencies in a certain measure the same effects may be obtained as with high frequencies, provided the rate of change is sufficiently great. So if a low frequency current is raised to a potential of say 75,000 volts, and the high tension current passed through a series of high resistance filaments, the importance of the rarefied gas surrounding the filament is clearly noted, as will be seen later; or, if a low frequency current of several thousand amperes is passed through a metal bar, striking phenomena of impedance are observed, just as with currents of high frequencies. But it is, of course, evident that with low frequency currents it is impossible to obtain such rates of change per unit of time as with high frequencies, hence the effects produced by the latter are much more prominent. It was deemed advisable to make the preceding remarks, inasmuch as many more recently described effects have been unwittingly identified with high frequencies. Frequency alone in reality does not mean anything, except when an undisturbed harmonic oscillation is considered.

(To be Continued.)

ENGINES FOR ELECTRIC WORK.

To the Editor of the CANADIAN ELECTRICAL NEWS.

SIR,—I was much interested in reading an article in your July number in regard to engines for operating generators for street railway work, and, as electric railways are increasing rapidly, I have no doubt your timely reference to the subject would receive close attention from a large number of your readers who are engaged in this work. Believing that your object is not only to furnish much needed advice, but to call forth discussion and criticism, I venture to discuss some points raised by you, and give the results of some little observation and experience.

I fully agree with you that compounding should not be adopted unless there is available either a supply of water for condensing, or a very high steam pressure, and I believe that frequently a loss and waste is sustained both in electric lighting and railway plants, particularly the latter, where the load fluctuates very greatly, when these conditions are not obtained. But in reference to the low speed engine being best, I think a full and unbiased investigation of all the conditions found in electric work would demonstrate that in many instances the high speed engine would possess advantages which would give it the preference for such circumstances. You hit the nail on the head when you say that "there are times when an engine being used for that purpose is suddenly required to jump from a few to hundreds of horse power in but a few seconds of time," and I think it will not be out of place to add that these sudden fluctuations are constantly taking place, and, if the engine does not respond instantly to the sudden increase or decrease of load, the electric generators and motors will suffer severely. A moment's consideration will demonstrate, to those who have not already learned it by experience, that it is not possible for a low speed engine to regulate as quickly or maintain as even speed under sudden changes of load, as one of the high speed type, for three reasons:

1st. Because the governing mechanism, employing any of the forms of trip cut-off gear, will not respond as readily to sudden changes as a rapidly revolving fly-wheel governor, directly connected to the cut-off valve.

2nd. The trip cut-off only has an opportunity to control the speed during a very small part of each stroke, viz: from the time of admission to the time of cut-off, which may be only one-sixteenth, one-eighth, or at latest one-half the stroke, so that it is impossible, even with the aid of a very heavy balance wheel, to make the engine respond to a sudden change of load, should it come after cut off has taken place, while the high speed engine, with single valve attached direct to the governor, operating both cut-off and compression, has control during nearly the whole stroke, after cut-off has taken place, the governor may still hasten or retard compression, thus decreasing or increasing the area of card.

3rd. The opportunities for regulation will occur more frequently in the high speed engine, just in proportion to its greater rate of revolution in a given time, than a slow speed one. If the slow speed engine makes 80 R. P. M. and the high speed one 250, the latter will have about three chances for regulation to one of the former. Your suggestion that the cranks be placed at 90 degrees will not help the difficulty I think, if a compound engine be used, because in that case a large receiver should be used to equalize the pressure between the high and low pressure cylinders, and, if a sudden increase in work be required, several strokes will elapse before a sufficient pressure will reach the low pressure cylinder to meet the increased load, consequently the engine will lose speed, and for the same reason an increase of speed will take place from a sudden decrease of load.

In regard to the relative economy of high and low speed engines, I believe the difference in steam consumption of the two types of engines has not been accurately determined, and, as the economy of any type of engine depends so much upon the conditions of work, probably it cannot be definitely fixed. It seems, however, to be pretty well established that a long stroke engine, under the best conditions, as to number of expansions to suit the steam pressure, etc., will develop a horse power with less steam than a short stroke one, working under similar conditions, but it is also well known that a long stroke engine is very wasteful under light loads, and, although the high speed engine also will not be as economical under light loads as when working with its best rate of expansion, it is quite certain that it will not be as wasteful relatively, as the long stroke one. This is due to a variety of causes, the discussion of which would require too much space to be treated fully here, but briefly may be stated as due to the variable compression of the single valve high speed engine which tends to equalize the temperature in the cylinder, and, as the power is increased or decreased, both by altering the cut-off and compression, less variation of cut-off takes place for a given change of load. In a high speed engine, a loop in the indicator card showing expansion below the atmosphere is rarely seen, while in a long stroke engine with fixed compression it is very common. From experience the writer believes that in very many cases, particularly for electric railway plants, where the load ranges between wide extremes, the high speed engine is more economical, or rather less wasteful, than the low speed one.

Now, as to the "frequent and expensive repairs of high speed engines," although I think some engineers, through unfortunate experience with high speed engines, are liable to lay more stress on high speed as a course of trouble than it deserves, it is undoubtedly true that very many so called high speed engines have been supplied for electric work which have caused so much annoyance and trouble that it would have paid their purchasers to cast them aside, and substitute the more mature and reliable long stroke engine, with its greater cost for foundations and room, besides a possible loss of power, and wear in countershafting and belts, but it must be remembered that the long stroke engine has had a much longer and more favorable chance for development than the more recent high speed machine, which is the natural outcome of the high rotative speeds and limited space frequently available for enormous electric installations; and, because the high speed engine has not at once reached the desired and necessary perfection, I do not see that it should be too hastily condemned. If this course had been followed in other lines of steam engineering, where would the locomotive and marine engine be? (the latter, combining at once the highest economy in steam, and the greatest amount of power, in the most limited space and least possible weight). If past experience may be taken as indicating the future trend in this direction, I think it would be safe to predict that the high speed engine is the coming steam motor.

It may not be out of place to state briefly some of the grounds on which the writer bases his belief that the high speed engine will continue to be improved until it will be used not only on account of its convenience for driving high speed machinery, economy of room and perfection of regulation, which perhaps are the only reasons for its use at present, but, we believe will be brought to such a state of perfection that it will bear favorable comparison with, if not outstrip, its faithful progenitor the long stroke engine, in durability and even economy in fuel. The reasons for this belief may be stated briefly as follows:—It is a well known fact that relative speed is not necessarily an element of either friction or air. If a journal be perfectly true and smooth, and properly and continuously lubricated, it does not matter whether it run at 100 revolutions or 1000. It has been stated by eminent and experienced engineers that perfection in workmanship and lubrication are the only limits to rotative speed, and every mechanic, who is at all acquainted with the history of mechanics, knows that it is more easy to-day to produce a machine that will run without heating and wear at 1000 revolutions, than it was, before the present era of perfection in engine lathes, exact measurements, and journal grinding appliances, to get 100 revolutions satisfactorily. (Many engineers can probably remember engines that it was difficult to hold together at 50 revolutions.)

Just a moment's consideration of the reasons why journals wear and heat—it is because the metals of which they are composed are not completely separated by oil. If they were they could not do either. How is it possible to separate them? Take two surface plates, and put a thin film of oil between them, and see how much weight they will bear, distributed evenly upon the three points of support of the upper one, before the oil will be forced out, and the plate refuses to move. Arrange a continuous supply of oil, and the surfaces will never come in contact. The perfection of surfaces in round journals will give like results. I I mean that, if the surfaces are perfect, and the load in proportion to the size of journal, it will never wear, if continuously and sufficiently lubricated, no matter what the speed or movement. The wear and consequent heating will always be in proportion to the imperfection of surfaces or lubrication, and, if either of these is imperfect, then increase of speed will increase the rate of destruction. If the journals are simply turned in a lathe, the unevenness of the metal, springing of the tool, and heating, will cause the surface to be lumpy and irregular; filing will only tend to smooth it without making it round. These lumps on a journal project through the oil, resting on the metal of the box, and will continue to wear until they wear below other portions of the surface, when some other place takes the wear, and so on. This defect may be remedied in round bearings by careful grinding operations, and flat surfaces may be made true by scraping to surface plate; both of these operations are now well understood, and constantly practiced in the best machine shops. Springing of the shaft or frame of the engine, or insufficient bearing surface, is the result of imperfect design, and may also cause heating and wear.

The high speed engine is in itself such a simple and apparently harmless affair, that many manufacturers, engaged in other lines of machine work, perhaps slow speed engires, not requiring such special attention to the perfection of wearing surfaces, have been tempted to copy somebody's high speed engine, or originate one of their own, and have found to their sorrow that it was a much more troublesome business, both for themselves and their customers, than they anticipated, and as a result have cursed speed as the cause of all their woes, and have led others to do the same, when the trouble lay not in the nasty little engine, but in their not understanding the business. However, although high speed engines are built which are anything but nasty, and are a credit to the preseverance and skill of their designers and builders, there is still room for improvement in the way of overcoming the twisting and vibration of parts, more simple and perfect lubrication, reliable oiling devices, and economy of steam, but who will doubt that the same skill and ingenuity which has made it possible to produce good watches by machinery, and to construct engines which will develop thousands of horse power economically for days and nights without pause, in the cramped up hold of a ship, will likewise evolve an engine for electric work, which will at the same time have high rotative speed, good regulation, durability, and highest steam economy. Any engineer who has visited the Chicago Fair must have realized that rapid strides are being made in this direction, and that this result will be attained unless something intervenes to throw the steam engine out of the race entirely.

D. W. ROBB.

SUNDRY NOTES ON HEAT. *

By CHAS. HEAL.

I lay no claim to originality in this paper, the matter having been gleaned from time to time from standard works and papers, and memorized or recorded in my note books. The object of the paper is not to settle any theoretical tangle, but to create discussion. Further, I wish you to understand that I am not here as a teacher, only as a learner, and I hope the members will give all the aid in their power either by reading a paper or giving their experience on any matter appertaining to steam, electricity or kindred subjects. There is no such thing as knowing it all; the most diligent only learns what he can, and that learning continues through life to those that desire to work near the top. With these few preparatory remarks, I will now proceed with the paper.

The object of the study of steam and its application is to obtain the greatest possible amount of work with the least possible expenditure of fuel, and in order to arrive at a correct understanding of the principles which underlie the economical production and use of steam, we must study, among other subjects, the nature and effects of heat. And here a difficulty meets us which we cannot altogether overcome; which is to define what heat really is; it is however so familiar to us in the effects it produces on our bodies and on objects around us, that we need not be deterred in our enquiries from our inability to solve the question.

The chief physical source of heat which we enjoy is the sun, which, although situated at such a great distance, warms the earth with its rays. Of this source nothing is known. In addition to this external heat we have an internal source known as terrestrial heat; this heat is very great, and it is computed by scientists that at the depth of a few miles it is capable of melting the most refractory substances. Though we are mainly dependent on these sources for maintaining our temperature, there are mechanical and chemical sources which are of great importance to us, the most important being chemical action. Nearly all chemical combinations are attended with the production of a greater or less degree of heat, and it is the chemical combination termed "combustion" which we as engineers are mostly interested in. I will not touch directly on the subject of combustion as that will be dealt with in a separate paper.

The temperature of a body indicates how hot or how cold it is, and should be distinguished from the quantity of heat in that body; for example if a cup of water be taken from a vessel the temperature is the same, but the quantity of heat varies as the weight in each vessel, the temperature or intensity being measured by the thermometer, but the quantity of heat is the temperature multiplied by the weight in pounds.

The specific heat of bodies varies considerably, water being the highest of any (except hydrogen) it being the standard and considered as 1, while that of iron for instance is ·113=1/9, so that the quantity of heat that would raise one pound of iron through 9 degrees would only raise one pound of water through one degree. These properties are taken advantage of by the engineer to ascertain approximately the temperature of bodies beyond the range of the ordinary thermometer—the uptake of a boiler for instance. Nearly all bodies expand by the action of heat, and the mechanic and engineer have ever to keep in view this fact or disaster is the result. For instance, cracked boiler fronts and settings, broken steam pipes and leaky joints. At the same time this property is daily utilized in our workshops; cranks and pins are secured, locomotive tires shrunk on and many defects made good by the judicious application of heat.

The transfer of heat from one body to another may take place in any of the following ways: radiation, conduction or convection. Heat is given off from hot bodies in rays which radiate in all directions in straight lines; this is the process of radiation. Conduction is the process by which heat passes from hotter to colder bodies by contact. The conducting power of bodies varies considerably. Iron and copper are good conductors; wood and some mineral substances are bad ones. The engineer uses good conductors to transfer the heat from the furnace to the water in the boiler, and the poor ones to prevent loss of heat by radiation from steam pipes, cylinders, etc. Convection or carried heat is that which is transmitted from one point to another by currents; the freer and more direct the currents the more readily is the heat transmitted; steam boilers should be so constructed as to secure a free circulation of the water.

Before quantities of heat can be measured, we must have an unit of heat, just as we require an unit of weight or length as the pound or foot; and the unit of heat is the quantity required to raise one pound of water through one degree Fah. But the all important point with the engineer is the conversion of heat into work; we will therefore consider the relations between the two. By the term "work," is understood the overcoming of a resistance through space, and the amount of work done is measured by the resistance in pounds overcome, multiplied by the distance through which it is overcome in feet; thus if seven pounds be lifted through ten feet, 7 × 10=70 foot pounds. Thus it will be seen that work is not measured by the pound or foot, but by the product of the two, and the unit of work is the lifting of one pound through a vertical height of one foot, and is termed the foot pound. It will also be noticed that the unit of work has no reference to the time taken, as the same amount of work is done whether it takes one second or one hour. The power of an agent is measured by the rate it can do work, and is represented by the lifting of 33,000 pounds one foot high in one minute. In the case of pumping engines, the work done is measured by the foot pound, and is termed "duty" per pound of coal.

We will now consider the effect of heat in producing a change of state in different bodies, as ice, water and steam. The temperature of a body ceases to rise while it is melting. An illustration of this fact may be obtained in this way: take equal weights of water at 32 degrees and 174 degrees, and mix; the temperature of the mixture will be the mean of the two, 103 degrees, Now take equal weights of ice at 32 degrees and water at 174 degrees and mix as before; the temperature will be only 32 degrees instead of 103 degrees; all the ice however will be melted. The 142 degrees of heat have evidently been consumed in melting the ice and are now latent in the water, as this heat would require to be given off again befor the water could be transformed into ice. Were it noted for this provision, as soon as a body of water had sunk to 32 degrees, it would immediately become a mass of ice. A simple experiment which may easily be tried will enable any one to determine exactly the quantity of heat which becomes latent when ice is converted into water or water into steam. Procure a uniform source of heat, and place a pound of water over it to ascertain the exact amount its temperature rises in a given time. Assume it rises 10 degrees in one minute; now remove and place one pound of ice at a temperature below 32 degrees; the temperature will rise to 32 degrees and remain at that point until all the ice is melted, which will be in about 14 minutes. Now in this time the amount of heat would have raised one pound of water 10 degrees × 14 minutes=140 degrees—but the water is only 32 degrees—then the 140 degrees have been rendered latent. Continue the heat, and in 18 minutes it will have attained the boiling point 10 × 18+32=212 degrees. Still continue the heat, and in 95 minutes, or about 5½ times as long as it took to raise it from 32 degrees to 212 degrees, it will have all boiled away, and yet the temperature of the steam has at no time exceeded 212 degrees. All this heat, nearly 1000 degrees, has been rendered latent. It is this large amount of latent heat in steam that renders it so useful as a heating agent, and were it not for this property the moment water attained the boiling point would be one of extreme danger, as it would be immediately converted into steam with an explosive force akin to gunpowder.

I will continue this subject at a future meeting, and also internal and external work of steam and rejected heat.

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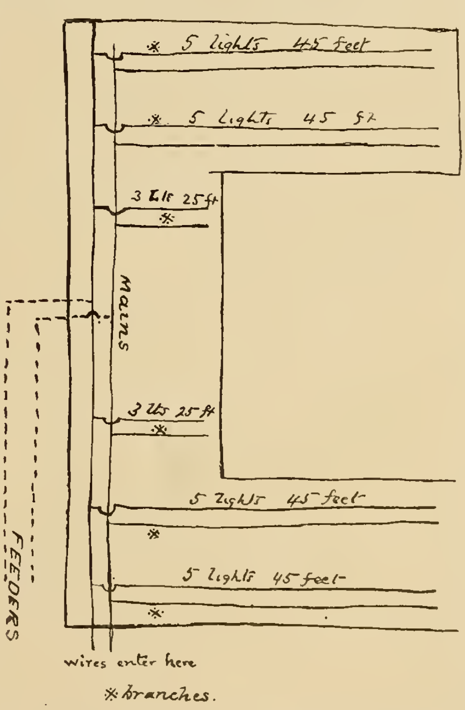
* Paper read before Toronto Association No. 1, C.A.S.E.

QUESTIONS AND ANSWERS.

Mr. A. H. M., Morrisburgh, Ont., writes: We are using a Leonard Ball engine and a boiler 54 in. diameter (74 flues 2⅝ in.), length of boiler 14 ft., length of grates now in use for wood or sawdust, 5 feet=width of fire place 3 ft. 6 in., and would like to get some information to burn soft steam coal, and what span there should be between grates and boiler, and the best grate to burn soft steam coal. Have plenty of draft for to burn coal or wood, saw-dust, &c., without any trouble. Any information you can give me will be gladly received.

ANS.—To burn soft coal under boiler described the grate bars might be placed 20 inches or 22 inches from the bottom of the boiler. Make grates about 4½ feet long and furnace from 3½ to 4 feet wide. The common grate bar about ⅞ of an inch thick at top and with ¾ inch air spaces between, answers well if coal is not too small. A flat bar with slots across it making ribs about ¼ in. thick and air spaces ¼ in. is used for small coal. There should be a dead plate between furnace door and front end bars and a brick bridge wall at back end built up to within eight inches of bottom of boiler.

"Subscriber," London, Ont., writes: Will you kindly inform me through the NEWS the proper way of determining the size of feed wire for the case shown in the accompanying diagram? In order to ascertain the number of C. M.'s should the distance be taken from the far end of furthest branch, or simply to where the last branch connects with the feeder? What is the title of the best book you know of on incandescent wiring, and where is it to be had?



ANS.—In the first place the main wires shown on sketch are not "feeders," but "mains." The proper way to distribute current for lighting this number of lights and distributed as they are, is by running a set of feed wires or feeders to the centre of the mains (as indicated by dotted lines and marginal references). The size of such feeders will vary according to the voltage of the lamps being lighted. The size of the mains can be determined by calculating for one-half their length for half the number of lights. The size of the branches should be calculated by measuring their full length if lights are all at the end, but if equally distributed along their entire length, then measure half the distance only. Badt's Incandescent Wiring Hand-Book is the best work on the subject of wiring. It may be obtained at this office. Price, $1.00.

T. O'Connor, Durham, Ont., writes: Kindly give me a receipt for a good leather belt cement.

ANS.—Fish glue, or a good quality of common glue.

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WE publish in the present issue two papers read before the Montreal Electric Club, which has resumed its meetings with a membership of about 25, and with every indication of a continuance of the interest which has marked its meetings and history in the past. We believe that the material is available in Toronto and in several other of the larger cities throughout Canada for the establishment of Clubs of similar character, and we hope to see steps taken in this direction. In Toronto the matter is already being discussed amongst those interested in electrical matters, and if some one will take the initiative, there is no reason why a Club should not be at once formed and hold meetings at regular intervals throughout the winter. As we have previously pointed out, the formation of such local Clubs would have a tendency to greatly increase the interest in electrical matters, and should also tend to strengthen the membership of the Canadian Electrical Association.

IN his address to the students and friends of the Toronto Technical School, at the recent opening ceremonies of that institution, Prof. Galbraith warned the students against fancying that there was much money to be easily made by working with electricity. He said: "It is a wrong idea to say that the time will soon come when men will disregard the steam engine and devote their attention entirely to developing turbines and water power. If it is possible to carry electricity long distances it will have the effect of developing water power, but will also do away with small steam plants and encourage the growth of large steam plants near coal mines and oil and gas engines near oil and gas wells. Consequently it is necessary for students in a technical school to study not simply the conveyance of power in the form of electricity, but also steam, heat, thermo-dynamics and chemistry. Chemistry is most closely involved in all applications of power. It is wrong to run off in one line because it happens to be popular. All branches must be carried out side by side. I think myself that the steam engine has reached a very high state of perfection. It is one of the most perfect examples of the development of machinery. Electricity is simply the means of conveying the power developed by engines and cannot take their place. Anyone who understands these engines will always have as good a chance as the electrician." These opinions, it will be noticed, coincide to a large extent with those expressed by several members of the Canadian Electrical Association in the discussion which took place at the recent convention on Mr. Merrill's paper on "The Education of the Electrical Engineer," and are without doubt well-founded.

IT is often the case that parties as well as individuals, have reason to wish to be saved from their friends. This is true at the present time of the opponents of Sunday street cars, to whom, after the amount of effort made a month or two ago to prevent the running of cars on Sunday in Toronto, it must have been a matter of great annoyance to observe two or three Hamilton clergymen going with a petition to the street railway company of that city, praying for the inauguration of a Sunday service. We observe that the Ministerial Association has since unanimously repudiated the action of these gentlemen. It appears that a selfish motive was behind the action, there having been a falling off in the receipts of one or two of the churches lately, as compared with the time when a limited Sunday street car service was in operation. In a city covering so small an area as Hamilton, there does not appear to be any pressing necessity for Sunday cars. Evidently the street railway company do not see much profit in the undertaking as they decline to establish a Sunday service unless a bonus sufficient to cover expenses is promised. This is in striking contrast to the action of the Toronto Railway Gompany who in view of the certainty of a large addition to their receipts, were so anxious to have Sunday cars established, that they willingly undertook to pay the cost of submitting the question to a vote of the citizens.

THE electric companies of Toronto are brought face to face with a difficulty which threatens to make serious inroads upon their profits, if indeed it does not in some instances wipe them out altogether. We refer to the action of the city assessment department in placing an assessment for the first time this year on the plant of these companies. In the case of the Toronto Electric Light Company, this assessment amounts to about $300,000, and calls for the payment of $7,000 yearly in taxes, or about one fifth of the company's total income. It is not difficult to realize what a tremendous burden this would be on almost any class of business, and on none perhaps would it fall more heavily than on electric lighting companies, as it is a well known fact to all who are familiar with the conditions, that excessive competition has reduced the profits of the business to a minimum. Electric lighting companies are under contract with the municipalities to furnish light at a certain fixed price for a definite number of years, and therefore it will be impossible for them to make good their loss by increasing prices, at least so far as street lighting is concerned. Even were this not the case they are obliged in many instances to maintain a price which will compete with gas. A most serious injustice with which the electric companies have to contend in competition with gas companies is, that under the assessment law the underground mains of the gas companies are exempt from taxation. Thus even in cases where, as in that of the Incandescent Light Company, of Toronto, the distribution of current is done by means of underground conduits, the electric light company's mains will be taxed while those of the gas company's will escape assessment. In a variety of ways therefore the electric companies are placed at a serious disadvantage, and unless in some way they can be relieved of this latest burden their already slender profits will as already stated in many instances be wiped out altogether. Another hardship is, that there is but one appeal from the decision of the Court of Revision, viz., to the county judge, whose decision is final. Should the efforts which will be made by the electric companies in Toronto to be relieved of this method of assessment, prove unavailing, then a united effort on the part of all the electrical companies of the province should be made at the next session of the Ontario Legislature to have the matter remedied.

THE very rapid progress that has been made during the past year in alternating current motors seems to make it clear that this method of utilizing the electric current for the supply of power, will be the one most used in the near future. Particularly will this apply to operating street railway motors. By means of it one of the most expensive features of the operation of these motors by the present direct current system will be entirely done away with, that is the use of a commutator on the motor. It is a well known fact that the frequent turning down of and the occasional renewal of the commutators is quite an item in the operating expenses of the present system. We do not wish to be understood as referring to the many two-phase or tri-phase, or poly-phase motors that are from time to time announced as being the only successful ones, our reference being to the single phase motor only as being the coming one for this use. There are now on the market stationary motors of this type operating as high as 10 or 12 horse power which we are informed are perfectly practical machines and which give an efficiency of from 70 to 80%, being self starters, and in every way the equal of direct current motors of the same size. It would seem then that it should only be a short step to applying them for the purposes mentioned above, particularly as no change in supplying the current to them would be required other than the putting up of a few circuits and mains to supply them with current. In fact there are various ways in which it would prove considerably superior to the present method; the opposite side of the converter could then be connected directly to the rails, making a much easier path for the return current than as now used. The current now has to traverse miles of poorly bonded rails or else find its way into the ground by way of water and gas pipes, causing in consequence any amount of annoyance to the companies or corporations who have the good keeping of these in their charge. With the present system this is becoming quite a serious matter indeed, one in fact which electrical engineers and scientists generally are doing their utmost to overcome, and so far with little result. Our opinion still is that the proper grounding of the rails will almost if not entirely remove the trouble. There would be absolutely none of this with the alternating current, particularly if it was returned to a converter every few hundred feet, as it would be if this system was being used. The trolley wire could then be one continuous wire as at present and the converters connected in multiple with it and the rails; or the trolley wire could be divided into sections with an insulating device of some kind between. Each converter would then be operating its own section entirely, and when there were no cars on it, its consumption of current would be next to nothing. For operating stationary motors of this type it would only be necessary to put a converter of sufficient capacity on the ordinary lighting mains; a separate system of power supply would then be unnecessary. Another point about the alternating system for street railway use would be that a current of primary wires and could be reduced to an absolutely safe one high voltage, say 2000 or 3000 volts, could be used on the for the working of the motors. This is a point of considerable importance, and one which would make the handling of either the wires or the motor even safer than under present methods. The possibility of underground trolley or contact wires would also be much simplified. The voltage could be kept so low on the trolley or contact wires as to almost preclude any possibility of its jumping its insulators in wet weather and thereby crippling the entire system for a short period, this trouble being one of the principal ones in underground systems that use a direct current of 500 or more volts. The only drawback at the present time to the adoption of stationary motors of this type is their very high price as compared with direct current motors. That is a matter which will right itself and very shortly if the demand can but be created for them and they become universally used.

NOTES FOR ENGINEERS.

A boiler feeding apparatus forms one of the most important attachment to a steam boiler. Whether a pump or injector be used there should always be at least two methods of getting water into the boiler while steam is up, and both should be in order, so that if one should suddenly fail, the other may be used before water has got too low in the boiler.

The injector in some of its many forms, is probably the most convenient style of boiler feeder. It is convenient, because with even a low pressure of steam it can be started to work and made to feed water into a boiler or into a tank. Steam from a low pressure boiler may be used to pump water into a boiler carrying a high pressure. The injector may be set to work without having to start an engine, or to run any shafting. For these reasons it is convenient, but let any one compare the cost of running one as compared with a pump, and it will be found that the injector uses far more steam. The injector is virtually a steam engine, in which the steam acts upon a water piston. It is the simplest form of engine, but probably the most expensive for fuel.

A steam pump if well arranged can be made as convenient as the injector, especially for large plants where there are many boilers, and will be found to be much more economical.

An ordinary plunger pump driven by shafting from the main engine of the factory is the most economical boiler feeder. Its advantage is, that it can only be used when main engine is running.

A good plan is to have a plunger pump driven by main engine for regular use when factory is running, and to have a steam pump or an injector for times when engine is standing.

If the feed water is hot, an injector will be found unreliable, as the water coming to injector must be cold enough to at once condense the steam.

If the pump is to be supplied with hot water, it must be placed at a lower level than the tank from which the hot water is supplied. A pump cannot lift hot water by suction, because as a vacuum is formed in the pump barrel, the pressure of the atmosphere is removed from the surface of the water in the suction pipe, and boiling takes place, and the pump barrel is filled with vapour. By putting the pump down lower than the tank, the water will flow into the pump.

Water at the atmospheric pressure boils at 212 degrees, but if the pressure is increased it will not boil till the temperature is much higher. If however, the pressure be reduced, and a partial vacuum formed, boiling and evaporation will take place at a much lower temperature.

* * *

In the transmission and diffusion of heat, three distinct processes are known, possibly there may be others: *Conduction* is the passage of heat from a hotter to a cooler portion of the same body. *Convection* is the term used to convey the idea that a hot body is put in motion and carries the heat with it. A current of hot water inside of a tank or boiler may be started by application of heat to one part of the tank, and by convection the whole of of the water will in time become heated. *Radiation.*—This term implies that a hot body loses heat and a cooler one absorbs it, while the air or other medium between the bodies is not heated by the transmission of heat from the one body to the other. It is by radiation that the heat from the sun reaches us. It passes through millions of miles of space, the temperature of which is estimated to be much lower than the lowest ever produced on the earth. The sun's rays do not seem to produce heat till their motion is stopped. Hence on a bright winter day, the sun shining into a room through a clean window, will raise the temperature upon which it shines, but it will not heat up the glass of the window nor the air in the room. The air by coming in contact with the heated carpet will absorb heat by a kind of conduction, and by convection will convey it to the other parts of the room.

TORONTO TECHNICAL SCHOOL.

LATE in the fall of 1891 the City Council passed a by-law establishing the Toronto Technical School, providing the means and appointing a Board, giving them full powers to obtain a building and equipment, to select a staff of teachers and to draw up a scheme whereby might be placed within the reach of mechanics and artisans and the employed of the city generally, the means of acquiring those elements of an education which would be of most value to them in the pursuit of their various avocations.

The preliminaries were attended to by the Board, but it was well on in January before the school could be opened. They had succeeded in securing for temporary use the building formerly occupied as Wycliffe College, on the north side of College street at the head of McCaul. It needed some refitting. From the start the school was well attended. The work of the first term was naturally to a great extent experimental, though by considering the special needs of the students and comparing the work done at various similar schools abroad, a programme was followed out which has not had to be materially altered excepting in the way of enlarging upon it and co-ordinating more thoroughly the different parts. This term extended to the first of May. Classes met five nights a week between eight and ten o'clock each night.

In October, 1892, the school re-opened, and again with a good attendance. This was expected to be the trying year. It was thought that the novelty of the appearance of this institution in Toronto might accounted for the good attendance during the opening term. If it tided over this year it would indicate that such a school could be of use. The register went up during the year to over three hundred and thirty, more than realizing the hopes of its most sanguine supporters. The school continued to thrive, though in cramped quarters, and with temporarily equipped class rooms. The students meant business, they came to learn; and the teaching staff worked with a will. The results were most satisfactory.

Again at the beginning of last month the school re-opened. The classes were crowded from the very start. As compared with a similar period last year the attendance this year has been multiplied by four. In the first week last year somewhat over 100 were registered; in the first week this year four hundred and fifty, and at the end of the second week five hundred and fifty were registered.

It is no longer a question whether there is room for such a school in Toronto. The experimental stage is past. It has come to stay. It is now for the city to show its appreciation of the value of such a school for the education of its mechanics and artisans by assisting it in its development, by providing it with more commodious quarters, and when necessary, by increase of staff or equipment. The sooner it is provided with better accommodations the better will be the results accomplished. It is now in a building greatly inadequate for the purpose. Why should not steps be taken at once to acquire for it better and permanent quarters? As long as it is cramped for room, and unable to separate the different grades and classes of work in the draughting room, as long as some of the elementary classes are three or four times their proper size, as long as chemistry, hydrostatics, light, heat, sound, electricity and electrical testing and laboratory work wait their turn in one small room, so long will the school be unable to accomplish the work that is evidently cut out for it in this city.

The ground at present covered by the course is comprised under the following heads: Mathematics (including arithmetic, algebra, Euclid and trigonometry); draughting (including practical mechanical, architectural and geometrical drawing and copying, as well as classes in practical geometry, orthographic and oblique projection, perspective, etc.); mechanics (including statics, kinematics and dynamics), physics (including hydrostatics, heat, sound, light and electricity and magnetism), ; and chemistry (inorganic). There are two classes, a junior and a senior, in algebra, Euclid, mechanics, draughting and descriptive geometry, electricity and chemistry. The junior course in electricity is a course of lectures which deal with the elementary principles and their practical applications, while the senior work will be to a great extent laboratory work, and will give the student the opportunity of becoming familiar with the ordinary relations between potential current and resistance by the individual use of the measuring instruments in various practical tests. The running conditions of generators and motors will also form a considerable part of the work.

The students in chemistry also have the opportunity of doing practical work in a chemical laboratory which has lately been fitted up for the purpose.

While the course as outlined is as extensive as can be expected under the present conditions, there are still channels along which it might be still further developed—even while keeping along the same general lines—which would be of great benefit to a considerable number of students. Some of these extensions have already been proposed, but cannot be carried out for lack of accommodations. Classes in decorative design, freehand drawing, etc., have often been asked for. There are a number of subjects that would be of value to engineers and mechanics, such as the working principles of the steam engine, the testing of materials for strength, etc., foundry and machine shop principles, etc., etc. Other extensions would suggest themselves if the school were allowed to develop freely.

The Toronto Technical School has started well, and we hope to see it continue to prosper. We are satisfied that the city which has generously supplied it during its earlier days when its existence was an experiment, will not now allow it to stop short of its full possibilities.

A VISIT TO THE CANADIAN GENERAL ELECTRIC COMPANY'S FACTORIES.

By invitation of the Canadian General Electric Company, a number of gentlemen prominent in electrical and business circles in Toronto and elsewhere, visited Peterboro', on Wednesday the 11th of October, and inspected the Company's works in that town. Among those who took part in the visit were: W. R. Brock, President; H. P. Dwight, First Vice-President; Frederic Nicholls, Second Vice-President and Managing Director; Robert Jaffray, J. K. Kerr, Q. C., W. D. Matthews, Hugh Ryan, Directors; W. S. Andrews, Comptroller, and the following guests:—T. Sutherland Stayner, President of the Bristol & West of England Loan Co.; Wm. McKenzie, President of the Toronto Railway Company; G. H. Campbell, Manager Winnipeg Electric Railway; Thos. Long; J. J. Wright, Manager Toronto Electric Light Company; Henry Lowndes; James Hedley, *Monetary Times*; W. J. Baines; E. A. Wills, Secretary Board of Trade; D. Creighton, the *Empire*; John F. Ellis, Managing Director Manufacturers' Life Insurance Co.; James Marwick, Westminster & Vancouver Tramway Co., Vancouver; W. R. Strickland; W. L. Symons; A. P. Poussette, Secretary Peterboro' Street Railway Co.; A. B. Smith, Superintendent Construction Great Northwestern Telegraph Co.; R. W. Ryan and John Taylor.

The factories consist of three brick and iron buildings, each 272 feet long and 80 feet wide, designated respectively the "Machine Shop," the "Compound Shop" and the "Wire Department." The site of these factories is 30 acres in extent, and switches from both the Grand Trunk and Canadian Pacific Railways have been built right into the yards thus affording facility for prompt and easy shipment.

These factories are thoroughly equipped with the latest improved machinery for the manufacture of the largest as well as the smallest devices and articles used in the electrical business. The machinery plant is operated by electric motors, the power for which is supplied from a 250 horse power triple expansion engine and boiler. The company were very much pleased and instructed by their visit. After having gone through the various departments of the works, they were carried by the newly completed electric street railway to the Oriental Hotel, where luncheon had been provided for them, and where they were joined by Messrs. James Stevenson, M. P., James Stratton, M. P. P., Mayor Kendry, members of the Town Council and prominent citizens. The party were next taken in charge by members of the town council, and shown the various points of interest, after which they re-embarked for Toronto.

THE HEAT UNIT.*

By Wm. Norris.

The object of this paper is to show the value of heat to actual work. I do not pretend to say that what is contained herein is by any means all that could be said on this very important subject. The part I wish to call your attention to, is that portion of the heat which is very often thrown away in the form of exhaust steam, and to impress upon the minds of my fellow engineers the great importance of securing a perfect understanding of principles,

I only intend to trace the heat from the time it enters the cylinder of a steam engine until it is exhausted into the atmosphere.

In the first place it would be as well to see what heat really is. It has been found by scientific reasoning that heat is the manifestation of motion in matter. Heat may be termed the foundation of power, or power itself, and heat is also life. Heat can be measured, and the standard of that measurement is called the heat unit. One heat unit is that portion of heat which will raise one pound of water one degree Fah., while in mechanical work one heat unit is equal to 772 foot pounds—that is, one unit is capable of lifting 772 lbs. one foot high, or in any other direction one foot, or one lb. 772 feet. Although heat is so powerful, yet a very small portion of it can be utilized for work, as will be seen before the end of this paper is reached.

The mechanical work performed by heat can only be produced by means of other substances, such as gas, air, water, steam, etc.; but in my opinion there can and will be more mechanical work produced from the heat stored up in carbon, than there is at the present day.

Heat may be expressed in two forms, namely, sensible heat and latent heat. Sensible heat is that portion of heat that can be felt or measured by means of a thermometer; while latent heat is that portion required to overcome the cohesive force of the water and raise it in temperature sufficient to overcome the pressure of the atmosphere. To convert one pound of water into steam at atmospheric pressure, from a temperature of 32 degrees, would require 1,146 units. Now the sensible heat of steam at that pressure would be 212 degrees, while that of latent heat is 966 degrees. If we were able to utilize all the heat stored up in one pound of carbon, which under perfect combustion contains 14,500 units of heat, we would be able to convert 12.65 pounds of water from a temperature of 32 degrees into steam at the pressure of the atmosphere. But in practice we come far short of that, for the common evaporative capacity of 14,500 heat units is from 6 to 9 pounds of water, although under most favorable circumstances better results might be obtained. I will not be able to deal with that part of the subject in this paper. However, we will suppose that 9 pounds of water is being evaporated for each pound of carbon containing 14,500 heat units, from a temperature of 32 degrees into steam at the pressure of the atmosphere. We would then lose 3871 heat units for each pound of carbon consumed. No work could be produced with steam at that pressure unless in a condensing engine and then with an energy of from 10 to 12 pounds per square inch.

Supposing we were using in a steam engine steam at 90 pounds pressure above that of the atmosphere, which would be 105 pounds per square inch absolute pressure, we would require an increase in temperature of 121 degrees of sensible heat, while that of latent heat would be decreased to 879.7 degrees; for as the pressure increases so does the sensible heat, but not in the same proportion as the latent heat decreases. Hence the total heat units required to convert 1 pound of water from 32 degrees into steam at 90 pounds per square inch, would be 1.181.

In the process of expansion we have given up 333 degrees of sensible heat, and discharged that steam at the pressure of the atmosphere, which is 212 degrees. So we have only used for work 121 degrees. We had a total of 1213 degrees and we have only used 121 degrees. So that nearly 90 per cent. of the heat entering the cylinder is thrown away unless used for other purooses. We have only used 121 degrees, while having lost 1060. So in this case only one tenth of the heat entering the cylinder would be utilized for work.

We will now take an engine of the following size, from which I will endeavor to show as nearly as possible the amount of lost heat in a given space of time under the conditions mentioned.

The diameter of cylinder is 20 inches; length of stroke 36 inches; number of revolutions per minute, 80; average pressure of steam throughout the stroke, 45 pounds per square inch; boiler pressure 90 pounds per square inch.

In one minute the cylinder has emptied itself 160 times. The temperature of the steam at 90 pounds pressure is 333 degrees of sensible heat, and in the process of expansion it gives up 121 degrees of its sensible heat each time it empties itself; then it would give up 19360 degrees in one minute.

Again, during the process of expansion there is considerable loss caused by condensation which is not the same in all engines, as it is greatly reduced when the cylinder is covered with a good non-conductor of heat. But in order that the exact amount of condensation caused by cooling of the cylinder walls and conducting the heat of the steam to the outside and by the expansion of the steam lowering the temperature and pressure, thus causing it to become saturated, special means must be applied.

With the engine in question we will assume that the loss by condensation is 10 per cent. A cylinder of this size and rate of piston travel would require 1047 cubic feet of steam per minute, and as there is 10% loss by condensation, it is necessary to add that amount to the total if we wish to ascertain the amount of water that is passing through the cylinder in one minute, So then we have 1151.9 cubic feet of steam used in one minute, and as there are 3.7 cubic inches of water in one cubic foot of steam at a pressure of 45 pounds per square inch, we would have 2.46 cubic feet of water evaporated in one minute, the weight of which would be 153.75 pounds. As we have found as nearly as possible the number of pounds of water used in one minute, we will proceed by the same method to find the number of heat units required to evaporate that amount into steam at a pressure of 45 pounds per square inch.

To convert one pound of water into steam at a pressure of 45 pounds per square inch from a temperature of 32 degrees, we would require 1.171 units of heat. Hence we have a total of 180,041 heat units per minute. But the steam when entering the cylinder had a pressure of 90 pounds per square inch, and with a temperature of 333 degrees of sensible heat, and we have utilized for work 121 degrees; then we have 19360 degrees that have performed work; subtract that amount from the total heat units per minute, and we have 160,681 units thrown away, unless used for other purposes, thus showing the great necessity of making use of the exhaust steam or the employment of a condensing engine. But before a decision of this sort can be arrived at, there are a great many things to be taken into consideration. I do not, however, intend to dwell on that feature of the subject.

As will he seen from the foregoing, the object of this paper is to show the amount of heat thrown away when an engine is exhausting into the open air. It is very seldom they exhaust with so little back pressure as I have allowed in this case; there would not otherwise have been such a good showing as is here made because had there been more back pressure the steam when exhausted would have been of a higher temperature; but I am allowing that the engine is doing its best. The average pressure of steam you will notice to be also in excess. What I wish to do is to bring as much of the heat as possible thrown away into practical use, such as heating buildings, etc. In heating buildings there are a great many things to be taken into consideration, especially when a system is to be calculated and laid out for heating with steam.

There are two methods of heating buildings, the direct and the indirect. The direct method consists of pipes in the room which heat the air already in the room, while the indirect method is the air heated in a separate chamber and conveyed by pipes to the room to be heated. The direct method is what we will now deal with, it being used mostly in mills. It consists usually of pipes around the wall near the floor. Where there are belts to circulate the air, the pipes are placed overhead. All buildings cannot be heated alike: for instance wooden buildings require more heating surface than stone, and stone more than brick. Then the size, location and character of construction of the building must be taken into consideration. Where a large number of windows is employed, more heating surface will be required. A long narrow room requires more heating surface than a square room of equal area.

The following figures are sometimes used for a general estimate, but good judgment must be exercised when these figures are to be employed: For heating dwellings from 40 to 50 cubic feet of air space to one square foot of heating surface, to heat to 70 degrees from an outside temperature of zero and low pressure steam. For large stores, 125 cubic feet of air space for one square foot of heating surface. Small stores, 100 cubic feet air space for one square foot of heating surface. Hotels, 125 cubic feet air space for one square foot heating surface. Churches, 200 cubic feet of air space for one square foot heating surface.

The rule I will make my calculations upon can be applied to condition, and will give more direct results: The amount of exposed surface; the desired temperature of the room; the temperature of the outside air; the temperature of the steam with which the room is to be heated are all concerned.

It has been found by careful experiments that one square foot of wall space will transmit from 70 to 1.25 units of heat per hour for every degree difference in temperature between the inside and the outside, the difference being caused by the action of the wind. In order to ascertain the amount of heat that will be transmitted through one square foot of wall space it will be well to take the lowest probable outside temperature and the highest transmitting capacity of the wall. Then from the desired temperature of the room subtract the lowest probable outside temperature and multiply the remainder by 1.25. This will give the number of heat units transmitted by each square foot of wall space for the space of one hour, multiply that amount by the area of the wall exposed in square feet, and the result will be the total heat units for one hour.

To find the heating surface we proceed as follows:—From the temperature of the steam subtract the temperature of the room; square the difference and divide by 100, which will give the number of heat units for each square foot of heating surface. Divide that into the total heat units required, and the quotient will be the number of square feet of heating surface for that pressure of steam. A three foot length of one inch pipe equals one square foot of heating surface. When a whole building is to be calculated the roof must also be included. All steam pipes act as heating surface. The diameter of the main in inches should be one-tenth the square root of the heating surface in square feet. It is as well to use one inch pipes for heating with live steam. For heating with exhaust steam two inch pipes are preferable. Return pipes should never be less than three-fourths the size of the mains.

In this paper we have been dealing with an engine from which we have got 158,606 heat units per minute, or 9,516,360 heat units per hour, after ten per cent. has been allowed for loss by condensation.

In concluding this paper it will be as well to read the results from beginning to end; also the working out of the rules, in order that the paper may be plainly understood. In the first place it required 1.146 heat units to raise the temperature of one pound of water to 212 degrees sensible heat, while that of latent heat is 966 degrees.

Steam at 90 pounds pressure requires 1181 units of heat for each pound of water from a temperature of 32 degrees, the sensible heat of steam at 90 pounds per square inch being 333 degrees and that of latent heat 879.7 degrees. The difference in temperature of steam at the pressure of the atmosphere and 90 pounds per square inch is 121 degrees.

When 9 pounds of water are being evaporated for each pound of carbon containing 14,500 heat units, only 315 units would be required to raise it from the pressure of the atmosphere to 90 pounds per square inch, and 10314 units to the pressure of the atmosphere. There would be 3871 heat units lost for every pound of carbon containing 14,500 units; and only 10 per cent. of the heat entering the cylinder would be utilized for work. The area of the cylinder was 314 square inches.; number of cubic feet of steam for one minute 1047. 2; while the total with 10% of condensed steam added, is 1151 cubic feet.

The number of cubic inches of water per minute was 4258.7. Number of cubic feet of water was 2.46. Number pounds of water 153.75. Number heat units required to convert one pound of water from a temperature of 32 degrees into steam at 45 pounds per square inch is 1171 degrees. Total heat units for that many pounds of water is 180,041 degrees.

There are 158,666 heat units carried away with the steam per minute, or 9,516,360 units per hour. The desired temperature of the room is 70 degrees. The temperature of the steam is 212°. The difference in temperature between the heat of the steam and the heat of the room is 142 degrees.

Number of heat units that one square foot of wall space will transmit per hour is 87.5. The total number of heat units that can be used for heating purposes is 1,179,168 degrees per hour. The number of square feet of wall space is 13476.2. Number heat units transmitted by one square foot of heating surface, is 201 degrees. Number of pounds of steam from which heat can be taken 138.4 Number of square feet of heating surface, 5847.88.

The diameter of main, 7.64 inches. The diameter of return, 6.5 inches.

The following will show plainly how the aforesaid results are obtained and with careful examination will be easily understood: 1146 − 212 = 966 degrees of latent heat. Heat units in one pound of steam when water is 32 degrees, 1213; then 1213 − 333.3 = 879-7 degrees latent heat. 966 − 879.7 = 86 3 degrees of latent heat and shown as sensible heat. So 333 3 − 212 = 121.3-86.3 = 57 × 9 = 315 additional heat units to raise 9 pounds of steam from the pressure of the atmosphere to 90 pounds per square inch—showing that the 121 degrees rise of temperature of steam at 90 pounds per square inch, is made up of the 86 3 decreased latent heat and 35 degrees from the coal, for 86.3 + 35 = 121.3 degrees.

It has required to raise 9 pounds of water from 32 degrees to the pressure of the atmosphere, 1146 × 9 = 10314 degrees, and to 10314 + 315 = 10629° - 14500° = 3871 heat units lost for every pound of carbon containing 14500 heat units. Then for the volume of the cylinder per minute: 20 × 20 = 400 × .7854 = 314.16 × 36 = 11309.76 × 160 = 1809561 ÷ 1728 = 1047.2 cubic feet per minute; and 1047.2 ÷ 100 = 10 47 × 10 = 104.7, ten per cent. of volume for one minute; then 1047.2 + 104.7 = 1151.9 cubic feet, had not 10 per cent. been lost by condensation ; and $1151 \times 3.7 = 4262 \div 1728 = 2.46 \times 62.5 = 153.75$ pounds of water per minute.

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* Paper read before Hamilton Association Canadian Association of Stationary Engineers.

The average pressure 45 pounds per square inch. Total heat units for steam at that pressure is 1203 ; the sensible heat is 294 degrees ; latent heat $909^\circ - 1203 - 32 = 1171$ heat units for one pound of steam at 45 pounds per square inch. Only the minute volume of the cylinder can be calculated upon, which is 10% off 153.75 lbs. water or steam altogether at 45 pounds per square inch ; then $153.75 \div 100 = 1.53 \times 10 = 15.3 - 153\ 75 = 138.4$ pounds to be calculated upon at the pressure of the atmosphere. Thus $1146 \times 138.4 = 158606 \times 60 = 9516360$ heat units per hour are being lost ; and the number of heat units that can be used for heating purposes is $212 - 70 = 142 \times 138.4 = 19652.8 \times 60 = 1179168$ heat units per hour.

For the heating surface $212 - 70 = 142 \times 142 = 20164 \div 100 = 201.64$ heat units transmitted by each square foot of heating surface ; and $201.64 \div 1179168 = 5847.88$ square feet of heating surface.

For square feet of wall space $70 - 0 = 70 \times 1.25 = 87.5 \div 1179168 = 13476.2$. Diameter of main steam pipe, $5847.88 = 76.46 \div 10 = 7.6$ inches. Diameter of return pipe, $7.6 \times 7{\cdot}6 = 57.76 \times .7854 = 45.36 \div 4 = 11.34 \times 3 = 34 \div .7854 = 43.29$, the square root of which is 6.5 inches.

CANADIAN ASSOCIATION OF STATIONERY ENGINEERS.

Note.—Secretaries of the various Associations are requested to forward us matter for publication in this Department not later than the 20th of each month.

TORONTO ASSOCIATION NO. 1.

At the last meeting of the above Association, the doors were thrown open to the public, and a paper read by Mr. Charles Heal on "Sundry Notes on Heat", was followed by an interesting discussion. The paper will be found printed in the present issue of the ELECTRICAL NEWS. A committee was appointed to make arrangements for the annual association dinner, which is to be held on the evening of Thanksgiving Day. Bro. Wickens promised a paper for the first meeting in November, which will be an open one also.

MONTREAL NO. 1.

The last meeting of the above Association, held on the 19th of October, was well attended. A large amount of business connected with the winding up of the convention affairs, was transacted. The souvenir committee reported a surplus of $300. This amount is to be invested in scientific books, which will form the nucleus of a library in the future. Mr. Laine, of the firm of Carrier, Laine & Company, Quebec, was elected an honorary member.

HAMILTON ASSOCIATION NO. 2.

The regular meeting held on Oct. 6th was well attended, and there seems to be a growing interest among the brethren. One of the most interesting events of the evening was the report of our delegates to convention, which was presented in glowing terms by Bro. Robertson. This Association is very grateful to the Montreal brethren for the way they treated our representatives, and trust that the results of the convention will long be felt in Montreal. Bro. Robertson also read a letter of condolence which this Association sent to the family of the late Bro. Angell, of Guelph, who was so suddenly called away after his return from the convention ; and another to Bro. J. Nie, of Hamilton No. 2, who had the misfortune to lose his little son.

Bro. Binnington was elected Vice-President to succeed Bro. Johnson, who has gone to Laprairie, Quebec.

Bro. Arthurs was also elected Assistant Financial Secretary.

This Association intends holding special meetings for reading of papers discussion, etc., during the winter months.

WM. NORRIS, Rec.-Secretary.

ST. LAURENT NO. 2.

Editor ELECTRICAL NEWS AND S. E. JOURNAL.

SIR,—I was present at the last meeting of St. Laurent No. 2, C. A. S. E., in Montreal, and as we very seldom see any report of their meetings in the NEWS, it may be interesting to Ontario engineers' to know how they are getting along.

No. 2 is flourishing in every sense of the word. Their membership has decreased somewhat since they were organized, but they themselves expected that, as many of the members took no interest in the work and so they fell out of the ranks in time. But those who remain number about 70, and they are determined to carry on the work of educating and helping each other in their profession.

On the evening in question there were several problems figured out on the black-board, including the safe working pressure of boilers and the thickness of plate required for a boiler to carry a certain pressure, and several others. There were several discussions on the above problems, but as they were carried on in the French language, (this Association being composed entirely of French Canadians), I did not get much good from it myself, but judging from the numerous questions asked and answers given, I feel sure that it resulted in some of the brothers learning something about boilers and their strength.

No. 2 St. Laurent meets in the Engineers Hall, 662 Craig St., and they hope before next convention to have another association in Montreal.

At the meeting the news of District-Deputy Bro. Angell's death was announced, and the brethren of No. 2 expressed their sorrow and regret by passing a resolution of condolence with the family of their late and esteemed brother, who was so suddenly removed from our midst, and ordered their charter draped for three months.

Executive President Bro. Geo. Hunt was also present for the first time, in his official capacity, and addressed the meeting in his usual happy manner, asking them for their earnest co-operation during the present term, in pushing on the work of organization of new Associations.

I remain, yours truly,
A. E. EDKINS,
Prov. Dep. C. A. S. E.

LONDON ASSOCIATION NO. 5.

A valued correspondent who is a member of the association writes : No. 5 is progressing favorably, and the officers are filling their posts to the entire satisfaction of the members, and are helping the younger engineers in their practice as well as enlightening them in their studies, which are hard, especially to those who have not had the benefit of early educational advantages.

We have a large blackboard which is used to illustrate methods of setting of boilers, engines, making calculations, etc. One of our members got up 25 paste board cards 20 x 24 inches, 10 of which contain diagrams, ranging in size from 10 to 20 inches, showing the theoretical curve, the different cut-offs and pressures, influence of clearance, under and overloaded engines, calculations of h. p. therein, etc.

Others show how to find the M. E. Pr., T. Pr., N. H. P., J. H. p, how to figure out the h. p. of diagrams ; explanation of the indicator. Reducing motions of all descriptions have been discussed and by means of wooden patterns every brother can try his hand at setting a slide valve. Piston distortion caused by the angularity of the connecting rod is also well shown on one of the cards, and shows itself just as plain on the pattern.

Safety-valve calculations, heating and grate surface, are subjects which are not forgotten. Interesting discussions have taken place in regard to firing boilers, showing the good results obtained by a good fireman as well as the great loss that can be caused by an ignorant one.

Personally I may say, I joined the C. A. S. E. 15 months ago, before which time I had never read an engineering book, but encouraged by ex-president Mitchell and Bro. A. E. Edkins to study, I have found out that books are the needed companions of a practical engineer. Every engineer should know the laws laid down for steam. As a result of my studies I have improved my old fashioned plant with the least possible outlay, reaping now better results with less fuel and less water consumption having no shut downs, diminished repair accounts, an easier day's work for myself, a pleasant face on my employer, and more wages.

GUELPH ASSOCIATION NO. 6.

At the regular meeting of Guelph Association No. 6, C. A. S. E., held on the evening of Oct. 4th, the following resolutions pertaining to the death of Bro. J. A. Angell were adopted.

Whereas it has pleased our Heavenly Father to call from our midst, our esteemed friend and brother, John A. Angell, be it resolved that, while we bow in humble submission to the Divine will, at the same time deploring the loss of so eminent an engineer, we extend our sincere and heartfelt sympathy to the bereaved family in their hour of trouble and sorrow.

Further, be it resolved that a copy of this resolution be sent to the deceased's family, and that it be spread on the records of our Association ; also that a copy of the same be sent to the CANADIAN ELECTRICAL NEWS for publication.

Furthermore, be it resolved that our charter be draped for the space of three months.

H. T. FLEWELLING Rec-Sec.
C. JORDAN, President.

KINGSTON ASSOCIATION NO. 10.

The engineers of Kingston who formed themselves into an independent Association about a year ago, have within the last month thrown in their lot with the C. A. S. E., and will be known as the Kingston Association No. 10. The new Association, which has a membership of upwards of 30, has elected the following officers: President, James Devlin; Vice-President, H. Youlden; Treasurer, H. Hoopins; Secretary, A. Strong; Conductor, James Lohern; Doorkeeper, James Gascoine.

Difficulty has already arisen between the Kingston Electric Street Railway Company and the City, resulting in an action by the Company for damages on account of loss of business through the failure of the City to keep the streets in proper repair.

Messrs. Ald. Savignac, Achambault, H. Laporte and R. T. Corbeil have been re-elected as the board of directors of the Merchants' Telephone Company of Montreal. The Company have erected 155 poles, and announce that their lines will be in operation by May next.

Over 400 tons of mica of various grades, are said to have been shipped from the Ottawa district during the months of July and August, and the first week of September. There is reported to be an increasing interest in and development of trade in the European market for mica of this district.

Captain Alex. H. Gunn, of London, England., has recently visited Montreal with the purpose of establishing a factory for the manufacture of a new electric cutting machine. This machine, it is said, will cut fabrics of every description and of many thicknesses, and with remarkable rapidity. It can be operated on any incandescent circuit.

SIGNALS AND TELEGRAPHY.*

By Jas. A. Douglas.

It is not my intention to present to this society to-night, anything more than merely a brief outline of the history of the transmission of messages from place to place, and to this end I have divided the subject into three parts: 1st, early attempts to signal to a distance; 2nd, development of the electric telegraph and telephone; 3rd, modern forms of signalling.

1st.—Early attempts to signal to a distance.—Probably the first good attempt to transmit messages by the aid of apparatus, was the employment of semaphores mounted on the top of high towers; these were erected in prominent positions, and in plain sight of each other. A large and well trained staff was necessary to observe and transmit, notwithstanding which the work was slowly done; besides the semaphores were useless in foggy weather or in storms.

Both of the two agents, sound and light, were used. Bells, guns, etc., form a convenient method for short distance work. Light, though more ready and rapid than sound, is by no means a docile agent, since it proceeds only in straight lines, and will not bend round the ball of the earth, or inequalities on its surface; and so the third agent, electricity, soon became recognized as docile and trustworthy; it rivals light in speed and can be adapted to any distance.

As far back as 1753, proposals were made to set up an electric signal line, consisting of a set of parallel wires, one wire to each letter of an alphabet, and make the wires attract light bodies, or strike bells corresponding to letters. Later on, Sommering, a German professor, carried this into effect to a certain extent, and he is sometimes regarded as the maker of the first practical electric telegraph.

The next step was the discovery of the deviation of the magnetic needle, through the action of an adjacent galvanic current, and Ampere, in 1820, showed how this could be used for telegraphic purposes. His plan was to use 30 needles and 60 wires, for at first it was supposed that there must be a separate needle for each letter or sign signalled, but this attempt reached no practical result.

The Paris Exhibition of 1881, contained the original first electro-magnetic telegraph apparatus of which practical use had been made. The credit belongs to Gauss and Weber, who erected a line 3,000 feet long at Gottingen in 1833. The apparatus consisted of a large galvanometer frame, in which a magnet carrying a small mirror was suspended by a silk thread. The sender consisted of a vertical inductive arrangement, which allowed a secondary coil to be raised vertically by means of a double lever. A quick motion of the coil generated an induced current which reached the galvanometer frame through wires, and caused the magnetic rod to be deflected. The direction of deviation was determined by the direction in which the coil was moved and a combination of these movements formed the alphabet. The call signal was given by means of a bell and clock-work.

Although this was the first accomplishment of electric telegraphy, yet their invention was regarded as only an appendage to their magnetic observatory, and several years passed before the electric telegraph was an actual fact.

2nd.—Development of the Electric Telegraph and Telephone.—The year 1837 saw the realized, practical, electric telegraph. We cannot claim the exclusive invention for any one individual, but of the several inventors, none seem to have shown greater skill and perseverance than Mr. Wheatstone, whose system of deflecting a single needle right and left, also using two needles, was in general use in England before Von Steinheil obtained similar success in Germany.

Steinheil later on improved the Gauss-Weber system and in his hands it became the first writing telegraph we have. He also made the very important discovery of "earth return," but this was received by the public as a "singular paradox," and Steinheil does not appear to have exerted himself to remove the prejudice against it, leaving it to an ingenious inventor, Mr. Bain, to independently discover this principle later on, and proclaim it, and also for M. Mattincci to make an entirely convincing experiment at Pisa in 1843. Then the double wire of the needle telegraph was dispensed with, and a single wire with ground return, was employed.

The needle system was much altered and changed by Wheatstone and others later, but it is to Morse that we owe our present efficient system of electro-magnetic telegraphy. The first registers or receivers ticked the message on a narrow roll of white paper, but this was soon dispensed with, as operators easily learned to read the instrument by sound alone.

To Prof. F. A. Petrina we owe the invention of duplex and multiplex telegraphy, which invention enables us to send two and more messages along the same wire, at the same time, in opposite directions, which makes the greatest use of a single wire.

Sub-marine cables were proposed as far back as 1774, but it was not until 1843 that the introduction of gutta-percha made this branch of the industry start into life. Many attempts and many failures resulted before the Atlantic ocean was successfully cabled, but the task was persevered in until in 1866 the Trans-Atlantic Telegraph Line was declared open for business. There is now no practical limit to the length of cable which could be laid if required, beyond the contingencies of severe weather.

The Telephone.—Perhaps the most wonderful, and certainly one of the most useful applications of electricity, is the telephone. It was discovered by Page in 1837 that an iron bar when magnetized and demagnetized at short intervals, emits sounds, and on this basis, Phillip Reiss constructed his first telephone. This must have been a curiosity, for according to Dr. Messel, it consisted of a beer-barrel, with a small cone placed in the bunghole, covered at its smaller end with an animal membrane, upon which a small platinum strip or wire was fastened by means of sealing wax. The receiver was a violin, upon which a knitting needle, having a coil wound round it, was fastened. The receiver was afterwards made in the form of a human ear in which the platinum wire was fastened to the membrane and to the spring by means of sealing wax; and a platinum contact was placed opposite with a screw for adjustment. When sound waves made the membrane vibrate, the circuit was made and broken.

For a long time efforts to improve the telephone gave very crude results, Elisha Gray succeeding in making a fair speaking system, which answered for short distances; the sender and receiver were funnel shaped and differently constructed. Bell also at this time made one, but the sender and receiver could not be used for the same purpose. This instrument was shown at Philadelphia in 1876, and satisfactory effects were obtained from it.

But before the telephone could be made of commercial importance, a problem had to be solved, which Hughes, an inventor, first applied—this was the principle of the microphone, an instrument with a conductor capable of changing its resistance with the sounding vibrations; this principle was discovered by du Moncel in 1856. Carbon was first made use of by Edison in his carbon telephone, and this was the beginning of a new era in this art, many forms of microphones and microphone telephones being tried and used by different inventors and improvers.

No instrument is so delicate as the telephone for the detection of small and sudden currents. It is admirably adapted for showing the currents of induction set up in contiguous coils. It also exploded the notion that iron takes time to magnetize and time to demagnetize. The notion of time is due to the action of induction in coils producing reaction and extra currents.

While it is possible to speak through a cable 100 miles long laid out straight in the sea, it is impossible to speak through 20 miles when coiled in a tank.

The first public experiments for telephone transmission of music were made in Vienna, in 1877. Bell's telephones were used both as senders and receivers. Also at the Paris exhibition in 1881, the music of one of the theatres was heard in distant rooms fitted up for the purpose.

From the first Bell had been working hard to perfect his idea of a proper telephone, and his ultimate form consisted in the well known present type of receiver.

Berliner's patent of 1877 is a miscrophone system. Each station, both receiving and sending, is similar in construction, and consists of a battery, an induction coil, and carbon contacts. The primary coils are in circuit with the battery and carbon contacts. The secondary coils being in circuit with the line wires, which system is in use to-day.

And so we see that the perfection of the telephone like that of the telegraph, was of slow but steady growth, and is the result of the experience and labor of many minds. As regards the efficiency of a telephone, it depends on the careful and exact workmanship with which the parts must be fitted.

3rd.—Modern forms of Signalling.—These are rather numerous, a description of which would fill a few good sized books.

We are all familiar with the electric bell, which summons us to the front door, the telephone, a fire, and sometimes dinner; also the telegraph and telephone, which convey our thoughts, wishes and news to all parts of the world, delivering their messages almost at the precise instant they are sent, to the office, parlor or side-tracked freight car, with equal facility.

Electricity in the form of incandescent lights and flashes, is used to signal between vessels at sea; also to warn them off dangerous coasts, or to signal from baloons to besieged cities, and other uses of military warfare in which the portable telephone is also playing its part.

Flags, by day, are used by army and navy for short distance work, and the heliograph, a tripod arrangement, is serviceable in sunshiny weather for signalling up to about 60 miles.

Limelight lanterns can also be used for short distance night work. These are constructed to emit short and long flashes corresponding to the dots and dashes of the telegraph code.

Electric resonators are used as whistles on small boats without steam. These are merely a powerful buzzer at the bottom of a hollow funnel-shaped vessel.

Loud sounding horns blown by steam are used by light-houses during foggy weather, which the lights will not pierce through to a sufficient distance to give warning.

As regards signalling generally, electricity by the aid of proper apparatus, can be made to perform any desired duty, and as nothing seems impossible to this subtle force, and with the many able minds at work on the problem, it is not too much to expect, that some day in the future, even the continents, separated as they are by vast oceans, will yet be able to converse as easily, as we in this city can ring each other up, and remind one another not to forget the next meeting of the Montreal Electric Club.

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* Paper read before the Montreal Electric Club, Sept. 25th, 1893.

ELECTRIC RAILWAY DEPARTMENT.

ELECTRIC RAILWAY EQUIPMENT.*

By H. O. Edwards.

I propose, to-night, to call your attention to some distinctive features in the electric railway equipments of to-day, and to make some few comparative statements. It would be useless for me to go back to the birth of the electric street car motor, for you are, probably, as well acquainted with its history as I, or if not, and yet are interested in this branch, the information can be found properly expressed and concisely stated in the works of Crosby, Bell and others.

At the risk of being thought clannish I will narrow my remarks to such apparatus as may be found in operation to-day in this fair country of ours, though I am sorry to say that much of it is made under another flag, and almost all the ideas come from abroad.

Since the first electric car was run in Canada, some eight years ago in Toronto, to the present day, great strides have been made.

The first road equipped and, regularly operated, was in Windsor, and the Vandepoel suspended trolley system was used about a year. Later a road was started in St. Catharines, using the Vandepoel double trolley system with a small motor on the platform of car connected by a chain with the axle, and I believe, is still in use in that city.

The Sprague motor, which was the first motor especially designed for street cars to be made and used in this country, is a small compact motor of light weight, capable of doing good work with a small amount of current, starting on 40 amperes. It had a double reduction gear, and is governed with a controller or switch-box, by commutating the fields. It was only rated at 15 h. p. and soon gave place to a heavier type of motor. The next motor was known as the Edison machine. This design followed closely on the lines of the Sprague. Unfortunately it was made to be controlled by the same method as the Sprague, and met with the same difficulties, namely, short-circuiting in the fields and grounding in the switch-box.

There is no kind of machine built, which is handled by such ignorant help as the car motor, nor any apparatus used more roughly and with less intelligence than the electric street car. A little more than a year ago our two largest cities, Montreal and Toronto, commenced to equip their street car systems with electricity, and, since that time our knowledge of the difficulties of keeping the cars on the rails and *on time* has been developed wonderfully. Toronto was the first to get under way, with cars equipped with the Edison system made in Peterboro'. These were supposed to be 20 h. p. motors, as already described. They gave very good satisfaction until they were overloaded with trailers, when the fields began to give out and the rest soon followed. Some cars equipped with Sprague motors rated at 15 h. p. gave the same results. Then came the call for heavier motors, and the Westinghouse 25 h. p. machines climbed to the front, where they still remain. This well-known type of machine needs no description, for these photos will give you a much better idea of it than I could hope to convey by words. The distinctive features of this system are, first, that the speed is governed by resistance in the field circuit, gradually cut out by a controller, somewhat similar to that used with the Sprague system. Second, the motor has four poles instead of two, as all other motors herein referred to have. Third, by a peculiar system of winding the armature the brushes are only 90° apart instead of 180°, as is necessary in all two pole motors. Fourthly, the mechanical details of this machine are very carefully designed and well made. All the wearing parts are made to last, and devices for taking up the wear are numerous. One of these cars has a record in Toronto, of thirteen months use without being brought into the shop for motor repairs. The draw-back in this motor is, that it takes from 80 to 100 amperes to start on a level, and about 40 amperes to run. The resistance is made up of coils of iron wire arranged in wooden frames, of which two are used in parallel on each car, giving a total resistance of 5½ ohms. The wire is No. 13, and is apt to become red hot, and burn off, sometimes setting fire to the frame and then to the car. The cylinder of the controller occasionally becomes grounded or open circuited, when it is necessary to take it all apart to remedy the defect.

The next machine to be tried was the T. H., also a 25 h. p. machine, known as W. P. 50. This was used with a semi-circular resistance box, over which runs an arm connected by a wire cable, with spindles on each end of the car, so that the resistance may be cut out as gradually as is desired. This machine is a standard and gives very good satisfaction, starting with 60 amperes and running on 25, making it a more efficient motor than its rival, the Westinghouse. In mechanical details it is not so well made, nor as convenient of access as the former. The wire cable by which the rheostat is operated, often breaks or gets foul of the one connected with the reversing switch, which is worked by a separate handle, thus differing from the controllers before referred to. You will readily understand that any ordinary man having three distinct systems under his control would not be satisfied until he had tried his hand at modifying or combining these. The electrician having charge in Toronto was no exception to this rule. His changes resulted in scrapping the Sprague controllers, using T. H. "J" controllers instead, and re-winding the fields of the Edison motors with No. 6 wire, thus doing away with the two weakest points in the Edison system. This gives a slow car taking a small amount of current, but, as weakening the fields does not strengthen the motor, it is not capable of doing very heavy work.

About the time that the first combination car made its appearance on the streets of Toronto, a car equipped by the Royal Electric Co., of Montreal, made its debut in that city. This equipment was designed and made in Montreal, and contains many of the good points of the T. H., Short, and Westinghouse systems. The inexperience of this company showed itself in many poorly constructed mechanical details, which have later been improved, so that shortly we may look for a standard electric railway equipment made right in our own city.

Before turning to note the progress of Montreal's electric road, we must take a glance at the admirable power house of the Toronto Railway Co. This is centrally located on Front st. at the corner of Frederick, and was designed by Mr. W. E. Davis, who deserves great credit for the thoroughness with which every detail is carried out. The steam equipment consists of four high speed compound Armington & Sims engines of 600 h. p. each, supplied by a battery of Babcock & Wilcox boilers, so arranged that any boiler or any engine may be cut off at will. Each engine is belted direct to two Edison generators of 200 kilowatts each, these giving a total output of 3000 amperes at 500 volts line pressure. There is also a spare engine and pair of generators. The station is well lighted by incandescent and arc lamps run off the power circuit, as well as by other lights run from the local mains, to be used when the power house is shut down. The switch-board is a piece of work which might stand as a model for any company to follow, and is far ahead of any that the writer had before seen. The switches were designed by Mr. Davis, and made in the company's workshop. They are on the horizontal blade principle, similar to the Edison main cut-out. They are strongly and handsomely made, and mounted on a finely finished slate switch-board of large size. They are so arranged that all or any machine may be thrown on all or any set of feeders, or that, in case of need any set of feeders can be loaded with 600 volts or more, if necessary. Standard meters are in circuit with each machine and a large tell-tale voltmeter can be used on any machine by a simple twist of the wrist.

Circuit breakers and lightning arresters are provided, and in every detail the power house shows the result of much study and careful consideration. I understand that the capacity of this station is soon to be doubled.

Now let us see what Montreal has been doing during this year, or more, heavily handicapped as she has been. The first cars operated here were equipped by the Royal Electric Co., with a motor made after the T. H. W. P. type rated at 20 h. p., and with controller and rheostat made from the Short patterns. Considering the limited time that the company had to get these out, their inexperience in this line of work, and the rail that the cars had to run on, as well as the way the cars were handled, this equipment was not such a blank failure as might have been expected, for some of those cars are still running. The snow made "Short" work of this style of controller, which has since been abandoned. Then came the Westinghouse, with the usual satisfactory results. At the same time cars having Edison motors with the T. H. "J" controllers were put on. These were also 20 h. p. machines, and the snow and ice played havoc with the wire cables, causing innumerable breakages, while water caused many burn-outs in the machine. Some T. H. equipments made in Lynn were also put on, but the "J" controller did not stand any better than on the Edison cars. Then began the combinations, in which local controllers and rheostats made at the railway company's shops at Hochelaga after the Westinghouse patterns, and the different types of motors, took part. Some of these combinations have been very satisfactory, notably on car No. 13, with rewound Edison motors, Royal rheostat and Westinghouse local controller.

During this time the Royal Co had not been idle, but not discouraged by their first lack of success, had brought out a new equipment, which I will describe at some length, for it is not so well known as the others, having been born on the 8th of June, and has not yet stopped growing to maturity.

Prefacing these remarks of the Royal motor, I would say that tests taken in Montreal and Toronto, by different parties, greatly differ in the results. I will vouch for the accuracy of those in which I took part in Toronto and will give them, hoping to be able at no distant date to prove the Montreal tests to have some other cause for their results than the apparent inefficiency of the Royal motors. These motors are practically water tight, for when the covers are closed water may be thrown on the motor and not a drop will enter. The shell consists of a cast iron box, somewhat rectangular in shape, with two pole pieces. It is made in two pieces. The lower part is hinged below the centre, and swings open, carrying the lower field and pole piece, when the armature may be readily removed by use of a hydraulic, or whiskey jack. The fields are wound on heavily insulated square brass spools with No. 5 wire and covered with cord; they are connected in series. The armature is of the Gramme ring variety, with an exceptionally heavy insulation, and wound with No. 10 wire. It, as well as the fields, is boiled in P. B. Compound and thoroughly baked. They are subjected to a test of 2000 volts alternating. The commutator is made of heavy copper segments, with a thick mica insulation between; this is tested with 250 volts between segments. The brush holders are placed diametrically opposite, and were designed to use two carbon brushes, 3 × 1½ × ⅞ placed side by side. This has been modified, and one brush 3 × 3 × ⅝ is now used instead with better results. The armature runs about 600 R. P. M. The reduction is about 5 to 1, giving a speed of 22½ miles per hour or 25 miles per hour with a light car and no stops. The motor is supplied with interchangeable gun metal bearings. The rheostat used was designed by Mr. Burnett after the principle used in the Short system. Layers of thin sheet iron plates between asbestos arranged in piles on a frame, the total resistance, cold, being about 3⅓ ohms. The controller differs from that used by the Westinghouse Co., first in having an independent reversing device operated by a separate handle; second in the roller being formed on a wooden core, thus leaving small chance for grounding and no possibility of an invisible open circuit as often occurs with that design; third, in having six notches instead of five, giving another section of resistance; fourth, in having the terminal board inside of the car instead of under the roller on the platform where dirt and moisture, as well as metal dust may fall on it.

When properly handled, the rings of the Royal controller need cleaning once a fortnight, and the tips have worn five weeks on a belt line route, equal to ten weeks of ordinary use. The Westinghouse needs to be cleaned once a day and tips changed once a week. Habirshaw wire and Okonite cable is used throughout the car. The usual fuse blocks, lightning arresters and motor cut outs were especially designed for this system.

I will read you the synopsis of a test taken by Messrs Davis, Smith and others, through the King street subway in Toronto on a car equipped with Royal motors:

Maximum current used to start on level, 60 amp. or 37½ h. p.
Minimum " " " " " " 40 " 23½ h. p.
Average " " " " " " 45 " 25 h. p.
Average " " " run " " 22 " 12 h. p.
Minimum " " " " " " 15 " 8 h. p.
Maximum " " on 8% grade 42 " 24½ h. p.

The daily average run of the car on which this test was made is 150½ miles, hauling a trailer 137½ miles at a rate of 8% miles per hour, including stops. During the Exhibition this car drew two closed trailers all day, carrying about 100 passengers on each car, mounting the 8½ grade of the subway with ease. Owing to the crowd it was impossible to make any tests as to amount of current used, but the usual fuse did not blow at any time.

To give you an idea of the difference of tests in the two cities, it has been reported that a car in Montreal similarly equipped. took 150 amperes, or 44 h. p., to climb the 8% grade on Windsor street; that is about double the power used on the same grade in Toronto.

I think it can be safely said that up to date, the Westinghouse is the most satisfactory equipment in use, for although the electrical efficiency is not so high as some others, the mechanical details are almost perfect, and this counts for something at the end of the year.

There is one other system in use in Niagara, Toronto and Kingston, which must not be omitted. It is the T. H. Series-Parallel or K. controller, and the W. P. 50 machines. By this system the motors are first in series and afterwards in parallel. On level roads a saving of one third of the current is claimed. The controller is rather complicated, but well made with blow-out magnets under each brake, and a separate roller for reversing the motors. The Niagara installation is looked upon as a model of this system, and has given most satisfactory results during the time it has been running.

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* Paper read before the Montreal Electric Club.

I intended to say something about the troubles met with in having the cars well inspected, as well as a few remarks in regard to the minor details of brushes, trolley-wheels etc., but I have already, occupied too much time. Trusting that you will all take part in discussing the points in this paper, wherein your views differ from mine, I will stop and give you a chance.

THE MONTREAL ELECTRIC CLUB.

The following meetings of this Club have been held :

The first meeting of the season was held at the rooms No. 55 University street on Sept. 15th, with a good attendance. The most interesting features of the evening were the exhibition by the inventor of Pinolet's Annunciator System and a paper on Signalling and Telegraphy, by J. A. Douglas, which is printed in the present issue. It is understood that this winter a committee will be appointed to draft out a set of underwriters' wiring rules for the guidance of architects and wiring contractors, the want of which has been much felt. A reliable system of inspection of wiring is to be recommended for the protection of house proprietors.

October 9th—The most important business on this evening was the presentation of the Constitution and By-Laws by the committee appointed for that purpose, the adoption of which was, however, left over till the next meeting. An instructive and interesting paper was read by Mr. H. O. Edwards on "Electric Railway Equipment," which is also printed in this paper.

October 23rd—Besides the transaction of other business, the revised Constitution and By-Laws submitted at the previous meeting were adopted. Mr. J. A. Douglas read a paper by Prof. Elhiu Thomson on "The Electric Arc and its Use in Lighting" which had been delivered by the author at a convention of the National Electric Light Association. The reading of this paper led to a considerable discussion on the part of the members of the Club.

TRADE NOTES.

Messrs. Quintard & Packard, dealers in electrical supplies have opened a branch of their business at Vancouver, B. C.

Mr. James Clark, in charge of Canadian Machinery Department at the World's Fair, has telegraphed the Robb Engineering Co. that their engine has been awarded medal and diploma.

We wish to congratulate the Penberthy Injector Co., of Detroit, Mich. on the fact, that to their justly celebrated Penberthy Automatic Injector has been awarded the medal for merit by the judges of awards at the World's Columbian Exposition. This injector has been on the market only six and a half years, yet nearly 75,000 of them have been placed on boilers in all parts of the world.

The Penberthy Injector Co., of Detroit, Mich., who have heretofore confined their efforts principally to injectors are as fast as possible getting out patterns for several new specialties to combine with their present business. Unless some complication unlooked for occurs, they will put on the market this coming season, a Sight Feed Lubricator, an Automatic Starter for Pumps or Injectors, a Low Water Alarm and a Lawn Sprinkler.

A circular has been issued announcing that the Ball Electric Light Company, Limited, of Canada, have sold to the Canadian General Electric Company, Limited, their entire electrical manufacturing business, including patterns and good will, and that the General Electric Company will continue the manufacture of Ball apparatus at their Peterboro' works It is also announced that Mr. W. A. Johnson, late manager of the Ball Company, will be the head of the arc lighting department, while also giving his attention to the special apparatus with which, as manager of the Ball Company, he is so familiar.

The Dodge Wood Split Pulley Co. are now doing an extensive trade among the makers of electric motors and dynamos. They supply a special dynamo and motor pulley made with iron centre and hardwood rim which is becoming very popular among the first-class makers. They claim for it all the strength of an all metal pulley, its arm, hub, and inner rim being iron, while the outside rim is built up of hard maple segments perfectly turned and highly polished, thus giving the user all the benefits of a wood belt surface. The Company show numerous samples of their special pulleys at their new and handsome city warerooms, 68 King Street West, Toronto, and are pleased to give information and prices to those interested.

Probably the largest mining transaction of the past year was consummated on Oct. 14, when Mr. W. R. Elmonhorst, of Montreal, sold all his interest in the lands, mining rights, equipment and mined material, comprising "The Lake Girard Mica System" To Mr. Thomas J. Watters, of Ottawa. By this operation, it is said, Mr. Watters becomes the absolute owner of the largest, the most valuable area of mica deposits, and proved properties, known to be held by any single individual on this continent. The development of the series of deposits in question has been steadily continued during the past three years, and the conditions of the various properties are such, that with a renewal of the demand for mica, which will doubtless arise ere long, the output of this mineral, which has been greatly restricted for the past few months, can be enormously increased. We understand arrangements are being perfected, whereby under lease of all said properties, etc., the business of "The Lake Girard Mica System" will be operated vigorously for the future.

The Magnolia Metal Company, having offices at New York, Chicago, London and all over the world, has been allotted the highest award possible at the World's Fair, Chicago, Ill., on their Magnolia Metal. A medal has been granted and a diploma with following specifications allowed and set forth : 1, It prevents hot boxes ; 2, It will not cut or heat journals ; 3, Its lasting qualities are of the highest order ; 4, It is a self-lubricating metal, saving large percentage of oil ; 5, It increases the motive power ; 6, It is the only metal that protects and does not wear journals—it enamels them ; 7, It is adapted to high and low speed machinery ; 8, It will stand the heavy work of sugar, rolling, saw and wire mills ; 9, It is a success for main journal and crank pin bearings ; also Gibs of steamships and steam tugs ; 10, It is the best water metal.

PERSONAL.

At the seventh annual convention of the Boiler Inspectors' Association of the United States and Canada, held recently at Chicago, Mr. Edwin O. Champagne, Inspector of Steam Boilers for the City of Montreal, was elected President. It was decided that the next convention of the Association should take place in Montreal.

Mr. D. Thomson, late manager of the Hamilton Electric Light and Power Company, has accepted a position with the Crouse-Tremaine Carbon Company, of Fostoria, O., and will represent the Company on the road both in the United States and Canada.

Under this heading last month it was stated that Mr. T. W. Martin had been appointed "manager" of the Hamilton Electric Light and Power Co. We are informed that this is incorrect, Mr. Martin's position being that of superintendent.

Mr. W. T. Dean, formerly of the Thomson-Houston International Co., of New York, has been appointed agent of the Canadian General Electric Co. for the Province of Quebec. His headquarters will be in Montreal. Mr. A. W. Congdon who formerly held this position has been appointed assistant chief engineer of the Company at Toronto.

The name of Mr. C. F. Medbury, of Ottawa, was inadvertently omitted from the list of those in attendance at the Canadian Electrical Association Convention, published in the ELECTRICAL NEWS for October. Mr. Medbury took an active part in the discussion on Mr. Langton's paper on "Direct Connected Dynamos with Steam Engines," and showed that the tendency is in the direction of slow speed direct connected dynamos, with consequent reduction in belt-speed and saving in belts.

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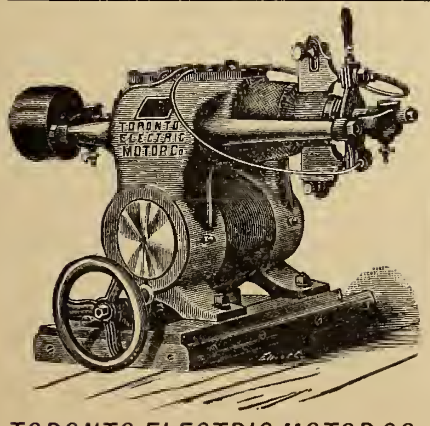
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SPARKS.

The construction of an electric railway in the town of Collingwood, is being agitated.

The General Electric Company are endeavoring to introduce incandescent lighting in Petrolia.

The Bell Telephone Company is making improvements on its systems at Port Arthur and Fort William.

The Bell Telephone Company are engaged in re-constructing their lines between Toronto and Port Hope.

The large new organ recently placed in St. Peter's Cathedral, Montreal, will be operated by an electric battery.

Mr. J. A. Farlinger, of Morrisburgh, has been granted a Canadian patent, No. 44,248, for a compressed air motor system.

The Vancouver and Westminster Electric Light Company has succeeded the Vancouver Electric Light and Power Company.

The Canadian General Electric Company has announced a dividend of 6 per cent. per annum for the year ending 31st of August, 1893.

A new power house is to be erected for the Electric Street Railway Company, in connection with the Winnipeg Gas and Electric Light Company.

During the month of September the receipts of the Toronto Street Railway Company were $92,745, as against $86,887 in the same month of 1892.

Incorporation has been granted Messrs. D. W. Clark & Sons, of Lancaster, N. B., to carry on the business of manufacturing electrical appliances. The capital stock is $22,500.

The directors of the Galt and Preston Railway Company have unanimously decided that the road shall be operated by electricity, and the merits of the various systems are now being looked into.

The chimney in connection with the General Electric Company's new station at London, Ont., will be the highest in the city. Its height is 125 feet, and in its erection there were used 107,000 bricks. The flue is 4 feet in diameter.

The Toronto and Richmond Hill Street Railway Company have entered into a contract with Mr. James F. McMahon, of St. Catharines, for the construction of the first section of their road, which will extend from the city limits to Bedford Park, and is to be completed by the 20th of December.

The following gentlemen have been elected directors of the Ottawa Car Company :—Messrs. Wm. Scott, W. W. Wylie, T. Ahearn, J. W. McRae and W. Y. Soper. The directors elected the following officers :—President, T. Ahearn ; vice-president, W. W. Wylie ; secretary-treasurer, J. D. Fraser; solicitor, Horace Pratt.

The street car conductor's life is not a happy one. If he fails to collect a fare he is liable to hear from the powers that be ; if he challenges a transfer passenger, that offended dignitary rises in his might in the Assize Court with a verdict of $500 damages. Moral : It is better to be a non-conductor just at present.—Toronto *Globe*.

It is reported that nearly all of the proposed $100,000 of capital stock of the Hamilton, Grimsby and Beamsville Electric Railway Company, has been taken up. Negotiations with the various municipalities, including the City of Hamilton, for the necessary right of way, have been going on for several months past. Mr. C. J. Myles is the President, and Mr. A. Rutherford, Secretary of the Company.

A messenger of the G. N. W. Telegraph Company surprised his employers by the celerity with which he delivered his messages, until the fact was discovered that his method was to tear up the messages and sign the name of the parties to whom they were addressed. The boy was brought before the Police Magistrate and sentenced to jail for 10 days. This it is hoped will serve as a sufficient warning to prevent the recurrence of so important a misdemeanor.

The following gentlemen have been elected directors of the Nelson, B. C., Electric Light Company :—James A. Gilker, President ; William Wilson, Vice-President ; Fred Richardson, Treasurer ; Geo. A. Bigelow, Secretary ; J. H. Matheson, E. R. Atherton and Fred. Williamson. The Company have expended upwards of $9,000 in obtaining a charter, purchasing land and making permanent improvements, and expect to have their plant in operation shortly.

While we would advise men not to rush heedlessly into the pursuit of electrical work with the idea that it is to extend into such a wide field in the future that there will be unlimited opportunities for profitable employment, we do think that since electricity is already applied to so many everyday uses, every one that has anything to do with it should understand as much as possible its elementary principles, so that he should know how to make use of it, what to do and what not to do, when there is danger and from what source. For those living in Toronto there is now an opportunity which a good many should avail themselves of, for thus becoming acquainted with electrical principles and their more common applications. Among other classes that have recently been started at the Toronto Technical School are a junior and a senior class in electricity, and we understand that the instructor in this department aims at treating the subject in a thoroughly practical way and in as simple a manner as the nature of the work will permit. His department is provided with a good equipment of electrical instruments, and generators, motors, etc., for practical tests and these with the assistance also of a projecting lantern, are continually used in the explanation of the principles.

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SPARKS.

It is reported that the St. John, N. B., street railway is in the hands of a receiver.

The Wiarton Electric Light Company have recently purchased a new 36 horse power engine.

A deposit of mica of excellent quality, is reported to have been discovered at Jasper House, N. W. T.

The construction of an electric railway from St. Thomas to Port Stanley, and connecting with the adjacent villages, is mooted.

The City of Brantford has completed a contract with the Brantford Electric Light and Power Company for street lighting for a period of five years. The price is 23 cents per light per night, for 35 or more lights.

A suit for $25,000 damages is said to have been entered by Mr. W. J. Austin, of Milwaukee, against the Goldie & McCulloch Company, of Galt, for alleged infringement by the latter company of a feed-water heater patent.

Mr. Geo. H. Campbell, manager of the Winnipeg Electric Street Railway Company, is at preseut in Ontario arranging for the purchase of additional rolling stock and other apparatus required to insure the efficiency of the operation of the road in winter.

The Vancouver and Westminster Electric Tramway and Light Company, Limited, has been incorporated, and will take over the Vancouver City Tramway and Light service, and the interurban tramway service between Vancouver and New Westminster.

The City of London has invited tenders for street lighting for a term of three or five years, with 2000 c. p. lights. The specifications provide that the current must not vary more than 8½ to 10 amperes and that the lights, 250 in number, are to be in operation before the 15th of January, 1894.

The Standard Electric Light Company of Montreal has disposed of its gas privileges and is now considering whether to build a railway from the Champ de Mars to Lachine, or to sell the privilege for doing so to parties who have made offers for it.

The cars which have been specially built for the purpose of carrying the mails to and from the railway depots at Ottawa, are vestibuled at each end with double doors at each side. There are no windows, the interior being lighted with electricity.

It is reported to be the intention of the Niagara Falls Street Railway Company to substitute electricity for horse power, and extend their line to Chippewa and Niagara on the Lake, with branch lines to Lundy's Lane and Macdonald's Corners. Permission will also be asked to cross the Suspension bridges and connect with the street car lines on the American side.

The electric railway connecting the towns of Port Arthur, Fort William and West Fort William, a distance of 8 miles, went into operation on the 27th of September. An hourly service between the three towns is to be inaugurated. The road was built and will be operated by the town of Port Arthur. Fort William has a right to buy a half interest in the road, any time within five years. It is hoped that the construction of this road will lead ultimately to the consolidation into one of the three towns mentioned.

The St. Thomas Motor Company has instituted a suit against Graham Symington, of St. Thomas, to recover possession of electrical machines and for damages for holding them. The defendant leased certain premises in St. Thomas to the Featherbone Co., which is now defunct. This company had bought dynamos from the motor company, and they remained on the premises after the company assigned. The motor company has a lien upon the dynamos, but Symington would not deliver them up, as he had a claim against the lessee. The defendant sets up a counter claim and asks $500 damages for possession.

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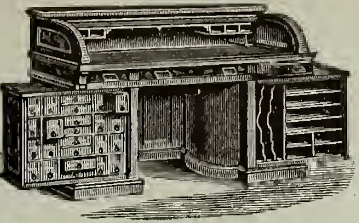

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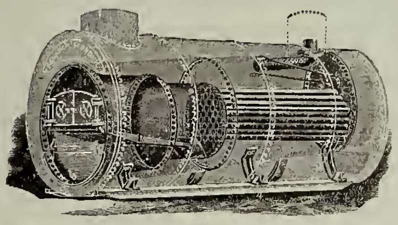

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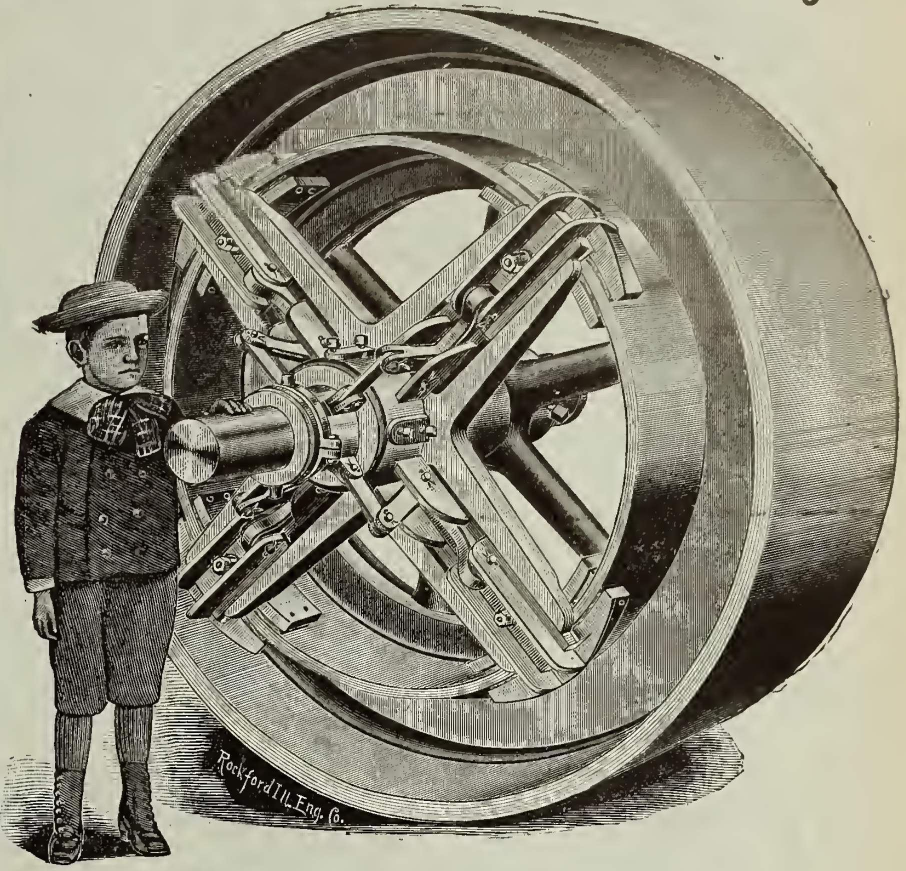
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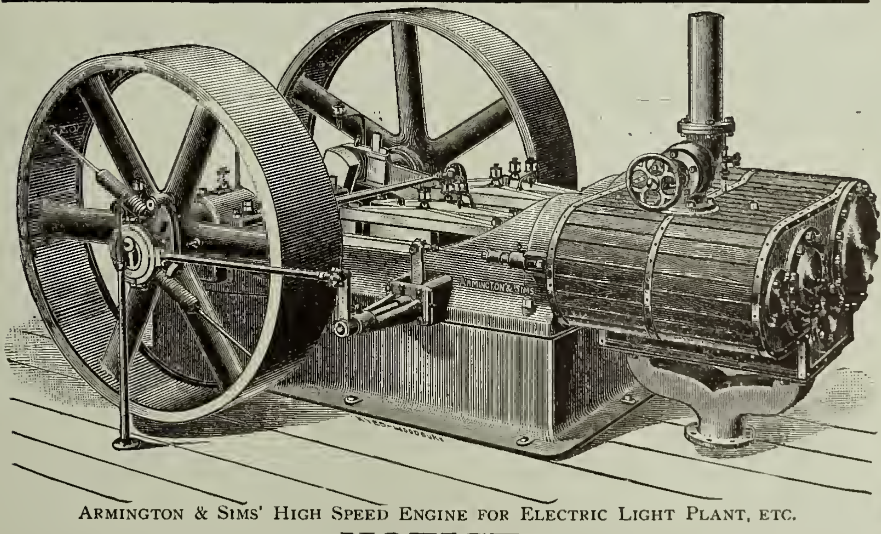

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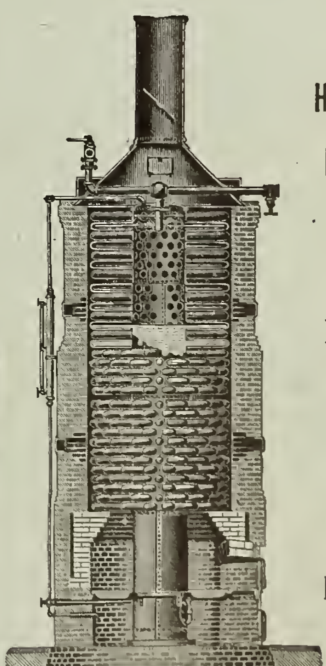

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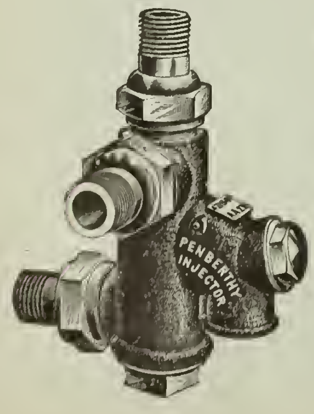

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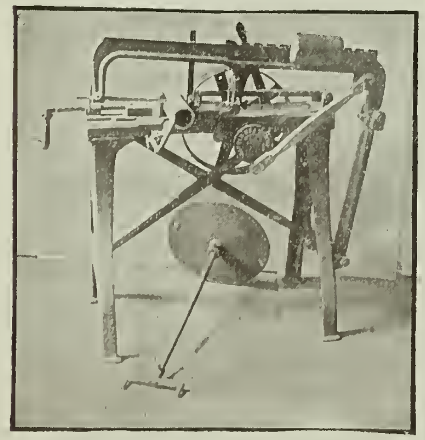

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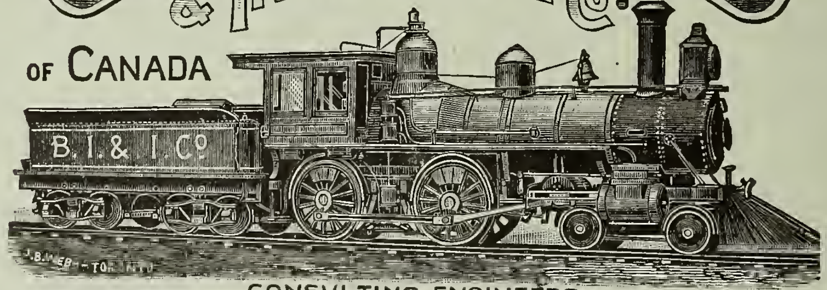
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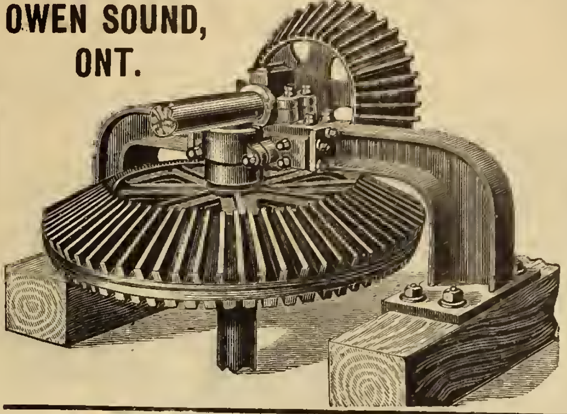

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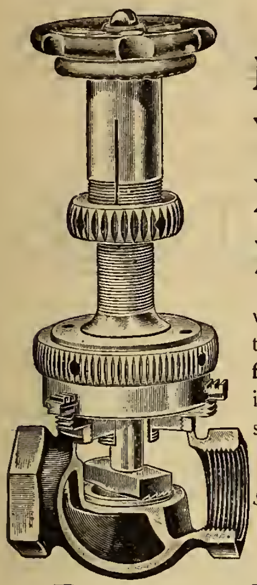

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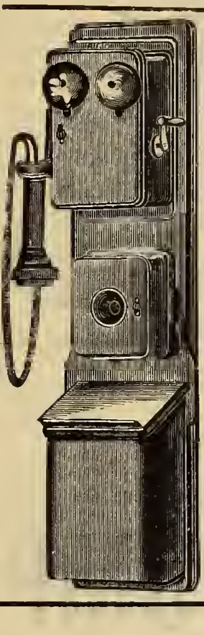

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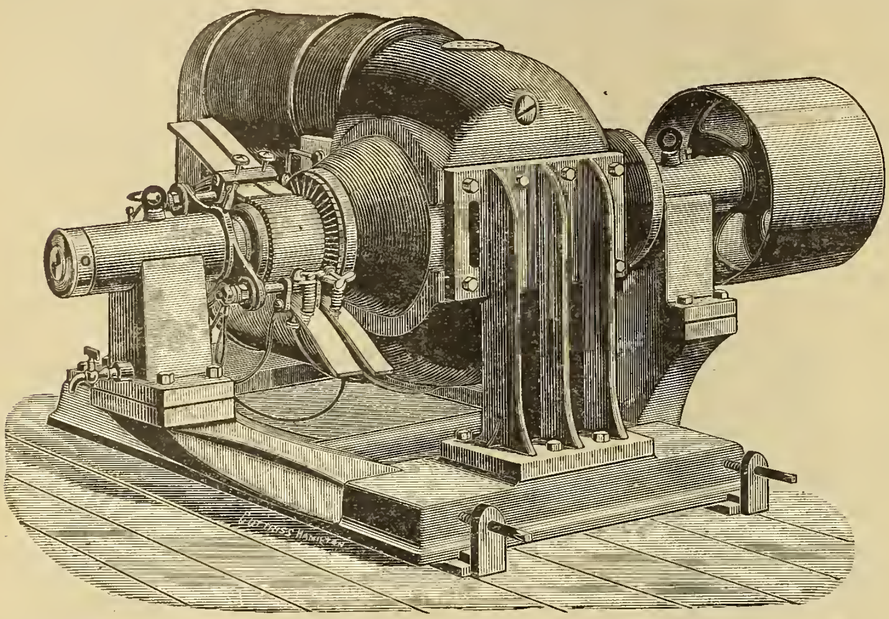

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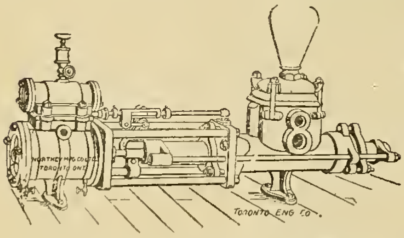
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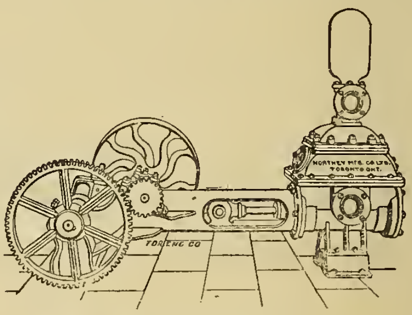
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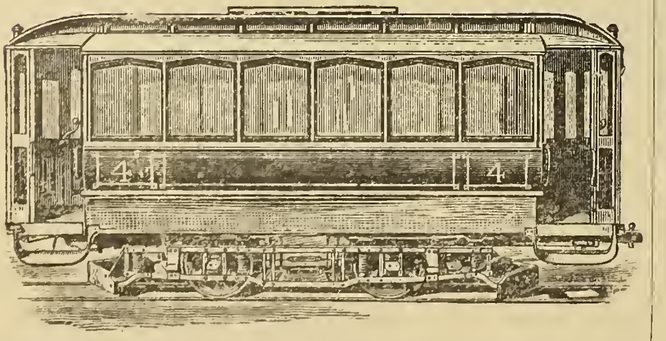

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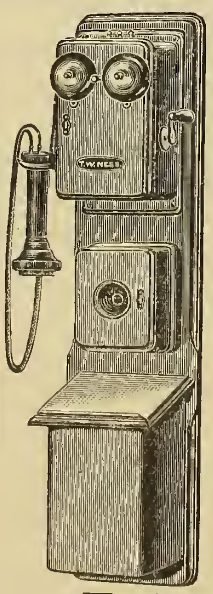

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VOL. III. DECEMBER, 1893 NO. 12.

ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.

BY NIKOLA TESLA.

(Continued.)

In the branch 3b a similar disposition as in 1b is illustrated, with the difference that the currents discharging through the gap d d are used to induce currents in the secondary S of a transformer T. In such case the secondary should be provided with an adjustable condenser for the purpose of tuning it to the primary.

Fig. 2b illustrates a plan of alternate current high frequency conversion, which is most frequently used, and which is found to be most convenient. This plan has been dwelt upon in detail on previous occasions, and need not be described here.

Some of these results were obtained by the use of a high frequency alternator. A description of such machine will be found in my original paper before the American Institute of Electrical Engineers, and in periodicals of that period, notably in the *Electrical Engineer* of March 18, 1891.

I will now proceed with the experiments.

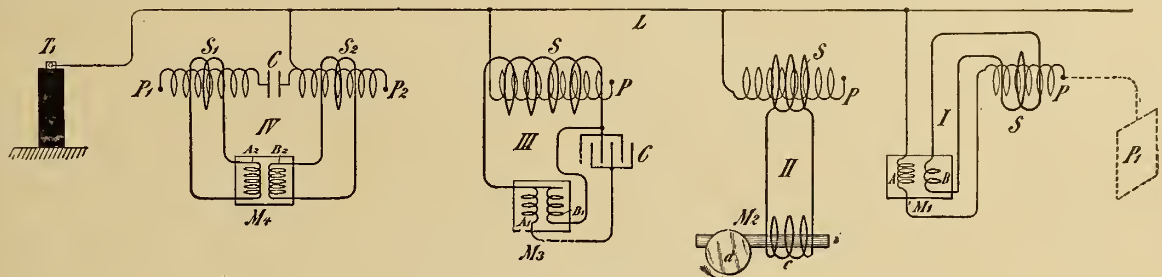


Fig.16

WAYS OF OPERATING MOTORS WITH ONLY ONE LEAD.

ON FHENOMENA PRODUCED BY ELECTROSTATIC FORCE.

The first class of effects I intend to show you are effects produced by electrostatic force. It is the force which governs the motion of the atoms which causes them to collide and develop the life-sustaining energy of heat and light, and which causes them to aggregate in an infinite variety of ways, according to Nature's fanciful designs, and to form all these wondrous structures we perceive around us; it is, in fact, if our present views be true, the most important force for us to consider in Nature. As the term electrostatic might imply a steady electric condition, it should be remarked that in these experiments the force is not constant, but varies at a rate which may be considered moderate, about one million times a second, or thereabouts. This enables me to produce many effects which are not producible with an unvarying force.

When two conducting bodies are insulated and electrified, we say that an electrostatic force is acting between them. This force manifests itself in attractions, repulsions and stresses in the bodies and space or medium without. So great may be the strain exerted in the air, or whatever separates the two conducting bodies, that it may break down, and we observe sparks or bundles of light or streamers, as they are called. These streamers form abundantly when the force through the air is rapidly varying. I will illustrate this action of electrostatic force in a novel experiment in which I will employ the induction coil before referred to. The coil is contained in a trough filled with oil, and placed under the table. The two ends of the secondary wire pass through the two thick columns of hard rubber, which protrude to some height above the table. It is necessary to insulate the ends or terminals of the secondary heavily with hard rubber, because even dry wood is by far too poor an insulator for these currents of enormous potential differences. On one of the terminals of the coil I have placed a large sphere of sheet brass, which is connected to a larger insulated brass plate, in order to enable me to perform the experiments under conditions which, as you will see, are more suitable for this experiment. I now set the coil to work and approach the free terminal with a metallic object held in my hand, this simply to avoid burns. As I approach the metallic object to a distance of eight or ten inches, a torrent of furious sparks breaks forth from the end of the secondary wire, which passes through the rubber column. The spark ceases when the medal in my hand touches the wire. My arm is now traversed by a powerful electric current, vibrating at about the rate of one million times a second. All around me the electrostatic force makes itself felt, and the air molecules and particles of dust flying about are acted upon and hammering violently against my body. So great is this agitation of the particles, that when the lights are turned out you may see streams of feeble light appear on some parts of my body. When such a streamer breaks out on any part of the body it produces a sensation like the pricking of a needle. Were the potentials sufficiently high and the frequency of the vibration rather low, rather low, the skin would probably be ruptured under the tremendous strain, and the blood would rush out with great force in the form of fine spray or jet so thin as to be invisible, just as oil will when placed on the positive terminal of a Holtz machine. This breaking through of the skin though it may seem impossible at first, would perhaps occur by reason of the tissues under the skin being incomparably better conducting. This, at least, appears plausible, judging from some observations.

I can make these streams of light visible to all, by touching with the metallic object one of the terminals as before, and approaching my free hand to the brass sphere, which is connected to the second terminal of the coil. As the hand is approached the air between it and the sphere, or in the immediate neighborhood, is more violently agitated and you see streams of light now break forth from my finger tips and from the whole hand (Fig. 5). Were I to approach the hand closer, powerful sparks would jump from the brass sphere to my hand, which might be injurious. The streamers offer no particular inconvenience, except that in the ends of the finger tips a burning sensation is felt. They should not be confounded with those produced by an influence machine, because in many respects they behave differently. I have attached the brass sphere and plate to one of the terminals in order to prevent the formation of visible streamers on that terminal, also in order to prevent sparks from jumping at a considerable distance. Besides the attachment is favorable for the working of the coil.

The streams of light which you have observed issuing from my hand are due to a potential of about 200,000 volts, alternating in irregular intervals, something like a million times a second. A vibration of the same amplitude, but four times as fast, to maintain which over 3,000,000 volts would be required, would be more than sufficient to envelop my body in a complete sheet of flame. But this flame would not burn me up; quite contrarily, the probability is that I would not be injured in the least. Yet a hundredth part of that energy, otherwise directed, would be amply sufficient to kill a person.

The amount of energy which may thus be passed into the body of a person depends on the frequency and potential of the currents, and by making both of these very great, a vast amount of energy may be passed into the body without causing any discomfort, except, perhaps, in the arm, which is traversed by a true conduction current. The reason why no pain in the body is felt, and no injurious effect noted, is that everywhere, if a current be imagined to flow through the body, the direction of its flow will be at right angles to the surface, hence the body of the experimenter offers an enormous section to the current, and the density is very small, with the exception of the arm, perhaps, where the density may be considerable. But if only a small fraction of that energy would be applied in such a way that a current would traverse the body in the same manner as a low frequency current, a shock would be received which might be fatal. A direct or low frequency alternating current is fatal, I think, principally because its distribution through the body is not uniform, as it must divide itself in minute streamlets of great density, whereby some organs are vitally injured. That such a process occurs I have not the least doubt, though no evidence might apparently exist or be found upon examination. The surest way to injure and destroy life is a continuous current, but the most painful is an alternating current of very low frequency. The expression of these views which are the result of long-continued experiment and observation, both with steady and varying currents, is elicited by the interest which is at present taken in this subject, and by the manifestly erroneous ideas which are daily propounded in journals on this subject.

I may illustrate an effect of an electrostatic force by another striking experiment, but before I must call your attention to one or two facts. I have said before, that when the medium between two oppositely electrified bodies is strained beyond a certain limit it gives way and, stated in popular language, the opposite electric charges unite and neutralize each other. This breaking down of the medium occurs principally when the force acting between the bodies is steady, or varies at a moderate rate. Were the variation sufficiently rapid such a destructive break would not occur, no matter how great the force, for all the energy would be spent in radiation, convection and mechanical and chemical action. Thus the spark length, or greatest distance through which a spark will jump between the electrified bodies, is the smaller the greater the variation or time rate of change. But this rule may be taken to be true only in a general way, when comparing rates which are widely different.

I will show you by an experiment the difference in the effect produced by a rapidly varying and a steady or moderately varying force. I have here two large circular brass plates p p (Fig. 6a and 6b), supported on movable insulating stands on the table, connected to the ends of the secondary of a similar coil as the one used before. I place the plates 10 or 12 inches apart, and set the coil to work. You see the whole space between the plates, nearly two cubic feet, filled with uniform light Fig. 6a. This light is due to the streamers you have seen in the first experiment, which are now much more intense. I have already pointed out the importance of these streamers in commercial apparatus and their still greater importance in some purely scientific investigations. Often they are too weak to be visible, but they always exist, consuming energy and modifying the action of the apparatus. When intense, as they are at present, they produce ozone in great quantity, and also as Prof. Crooks has pointed out, nitrous acid. So quick is the chemical action that if a coil such as this one is worked for a very long time, it will make the atmosphere of a small room unbearable, for the eyes and throat are attacked. But when moderately produced the streamers refresh the atmosphere wonderfully, like a thunderstorm, and exercise unquestionably a beneficial effect.

In this experiment the force acting between the plates changes in intensity and direction at a very rapid rate. I will now make the rate of change per unit time much smaller. This I effect by rendering the discharges through the primary of the induction coil less frequent, and also by diminishing the rapidity of the vibration in the secondary. The former result is conveniently secured by lowering the E. M. F. over the air gap in the primary circuit, the latter, by approaching the two brass plates to a distance of about three or four inches. When the coil is set to work you see no streamers or light between the plates, yet the medium between them is under a tremendous strain. I still further augment the strain by raising the E. M. F. in the primary circuit, and soon you see the air give way and the hall is illuminated by a shower of brilliant and noisy sparks, Fig. 6b. These sparks could be produced also with unvarying force; they have been for many years a familiar phenomenon, though they were usually obtained from entirely different apparatus. In describing these two phenomena, so radically different in appearance, I have advisedly spoken of a "force" acting between the plates. It would be in accordance with accepted views to say that there was an "alternating E. M. F." acting between the plates. This term is quite proper and applicable in all cases where there is evidence of at least a possibility of an essential interdependence of the electric state of the plates, or electric action in their neighborhood. But if the plates were removed to an infinite distance, or if at a finite distance, there is no probability or necessity whatever for such dependence. I prefer to us the term "electrostatic force," and to say that such a force is acting around each plate or electrified insulated body in general. There is an inconvenience in using this expression, as the term incidentally means a steady electric condition; but a proper nomenclature will eventually settle this difficulty.

I now return to the experiment to which I have already alluded, and with which I desire to illustrate a striking effect produced by a rapidly varying electrostatic force. I attach to the end of the wire l (Fig. 7), which is in connection with one of the terminals of the secondary of the induction coil, an exhausted bulb b. This bulb contains a thin carbon filament f, which is fastened to a platinum wire w, sealed in the glass and leading outside of the bulb where it connects to the wire l. The bulb may be exhausted to any degree attainable with ordinary apparatus. Just a moment before you have witnessed the breaking down of the air between the charged brass plates. You know that a plate of glass or any other insulating material, would break down in like manner. Had I, therefore, a metallic coating attached to the outside of the bulb, or placed near the same, and were this coating connected to the other terminal of the coil, you would be prepared to see the glass give way if the strain were sufficiently increased. Even were the coating not connected to the other terminal, but to an insulated plate, still, if you have followed recent developments, you would naturally expect a rupture of the glass.

But it will certainly surprise you to note that under the action of the varying electrostatic force the glass gives way when all other bodies are removed from the bulb. In fact, all the surrounding bodies we perceive might be removed to an infinite distance without affecting the result in the slightest. When the coil is set to work the glass is invariably broken through at the seal, or other narrow channel, and the vacuum is quickly impaired. Such a damaging break would not occur with a steady force, even if the same were many times greater. The break is due to the agitation of the molecules of the gas within the bulb, and outside of the same. This agitation, which is generally most violent in the narrow pointed channel near the seal causes a heating and rupture of the glass. This rupture, would, however, not occur, not even with a varying force, if the medium filling the inside of the bulb and that surrounding it were perfectly homogeneous. The break occurs much quicker if the top of the bulb is drawn out into a fine fibre. In bulbs used with these coils such narrow, pointed channels must therefore be avoided.

When a conducting body is immersed in air, or similar insulating medium, consisting of, or containing, small freely movable particles capable of being electrified, and when the electrification of the body is made to undergo a very rapid change—which is equivalent to saying that the electrostatic force acting around the body is varying in intensity—the small particles are attracted and repelled, and their violent impacts against the body may cause a mechanical motion of the latter. Phenomena of this kind are noteworthy, inasmuch as they have not been observed before with apparatus such as has been commonly in use. If a very light conducting sphere be suspended on an exceedingly fine wire, and charged to a steady potential, however high the sphere will remain at rest. Even if the potential would be rapidly varying, provided that the small particles of matter, molecules or atoms, are evenly distributed, no motion of the sphere should result. But if one side of the conducting sphere is covered with a thick insulating layer, the impacts of the particles will cause the sphere to move about, generally in irregular curves, Fig. 8a. In like manner, as I have shown on a previous occasion, a fan of metal sheet, Fig. 8b, covered partially with insulating material as indicated, and placed upon the terminal of the coil so as to turn freely in it, is spun around.

All these phenomena you have witnessed, and others, which will be shown later, are due to the presence of a medium like air, and would not occur in a continuous medium. The action of the air may be illustrated still better by the following experiment: I take a glass tube t, Fig. 9, of about an inch in diameter, which has a platinum wire w sealed in the lower end, and to which is attached a thin lamp filament f. I connect the wire with the terminal of the coil and set the coil to work. The platinum wire is now electrified positively and negatively in rapid succession, and the wire and air inside of the tube are rapidly heated by the impacts of the particles, which may be so violent as to render the filament incandescent. But if I pour oil in the tube, just as soon as the wire is covered with the oil, all action apparently ceases and there is no marked evidence of heating. The reason of this is that the oil is a practically continuous medium. The displacements in such a continuous medium are, with these frequencies, to all appearance incomparably smaller, than in air, hence the work performed in such a medium is insignificant. But oil would behave very differently with frequencies many times as great, for even though the displacements be small, if the frequency were much greater, considerable work might be performed in the oil.

The electrostatic attractions and repulsions between bodies of measurable dimensions are, of all the manifestations of this force, the first so-called electrical phenomena noted. But though they have been known to us for many centuries, the precise nature of the mechanism concerned in these actions is still unknown to us, and has not been even quite satisfactorily explained. What kind of mechanism must that be? We cannot help wondering when we observe two magnets attracting and repelling each other with a force of hundreds of pounds with apparently nothing between them. We have in our commercial dynamos magnets capable of sustaining in mid-air tons of weight. But what are even these forces acting between magnets when compared with the tremendous attractions and repulsions produced by electrostatic force, to which there is apparently no limit as to intensity. In lightning discharges bodies are often charged to so high a potential that they are thrown away with inconceivable force and torn asunder or shattered into fragments. Still even such effects cannot compare with the attractions and repulsions which exists between charged molecules or atoms, and which are sufficient to project them with speeds of many kilometres a second, so that under their violent impact bodies are rendered highly incandescent and are volatilized. It is of special interest for the thinker who inquires into the nature of these forces to note, that whereas the actions between individual molecules or atoms occur seemingly under any condition, the attractions and repulsions of bodies of measurable dimensions imply a medium possessing insulating properties. So, if air, either by being rarefied or heated, is rendered a more or less conducting, these actions between two electrified bodies practically cease, while the actions between the individual atoms continue to manifest themselves.

An experiment may serve as an illustration and as a means of bringing out other features of interest. Some time ago I showed that a lamp filament or wire mounted in a bulb and connected to one of the terminals of a high tension secondary coil is set spinning, the top of the filament generally describing a circle. This vibration was very energetic when the air in the bulb was at ordinary pressure, and became less energetic when the air in bulb was strongly compressed. It ceased altogether when the air was exhausted, so as to become comparatively good conducting. I found at that time that no vibration took place when the bulb was very highly exhausted. But I conjectured that the vibration which I ascribed to the electrostatic action between the walls of the bulb and the filament should take place also in a highly exhausted bulb. To test this under conditions which were more favorable, a bulb like the one in Fig. 10 was constructed. It comprised a globe b, in the neck of which was sealed a platinum wire w carrying a thin lamp filament f. In the lower part of the globe a tube t was sealed so as to surround the filament. The exhaustion was carried as far as it was practicable with the apparatus employed.

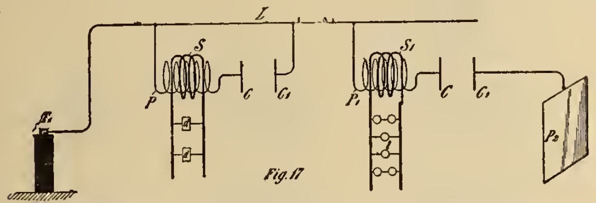


Fig. 17

SINGLE WIRE CONVERSION AND DISTRIBUTION, WITH SIMPLE MEANS FOR REGULATING THE EFFECTS.

This bulb verified my expectation, for the filament was set spinning when the current was turned on, and became incandescent. It also showed another interesting feature, bearing upon the preceding remarks, namely, when the filament had been kept incandescent some time, the narrow tube and the space inside were brought to an elevated temperature, and as the gas in the tube then became conducting the electrostatic attraction between the glass and the filament became very weak or ceased, and the filament came to rest. When it came to rest it would glow far more intensely. This was probably due to its assuming the position in the centre of the tube where the molecular bombardment was most intense, and also partly to the fact that the individual impacts were more violent and that no part of the supplied energy was converted into mechanical movement. Since, in accordance with accepted views, in this experiment the incandescence must be attributed to the impacts of the particles, molecules or atoms in the heated space, these particles must, therefore, in order to explain such action, be assumed to behave as independent carriers of electric charges immersed in an insulating medium ; yet there is no attractive force between the glass tube and the filament because the space in the tube is, as a whole, conducting.

It is of some interest to observe in this connection that whereas the attraction between two electrified bodies may cease owing to the impairing of the insulating power of the medium in which they are immersed, the repulsion between the bodies may still be observed. This may be explained in a plausible way. When the bodies are placed at some distance in a poorly conducting medium, such as slightly warmed or rarefied air, and are suddenly electrified, opposite electric charges being imparted to them, these charges equalize more or less by leakage through the air. But if the bodies are similarly electrified, there is less opportunity afforded for such dissipation, hence the repulsion observed in such case is greater than the attraction. Repulsive actions in a gaseous medium, are, however, as Prof Crookes has shown, enhanced by molecular bombardment.

ON CURRENT OR DYNAMIC ELECTRICITY PHENOMENA.

So far, I have considered principally effects produced by a varying electrostatic force in an insulating medium, such as air. When such a force is acting upon a conducting body of measurable dimensions, it causes within the same, or on its surface, displacements of the electricity and gives rise to electric currents, and these produce another kind of phenomena, some which I shall presently endeavor to illustrate. In presenting this second class of electric effects, I will avail myself principally of such as are producible without any return circuit, hoping to interest you the more by presenting these phenomena in a more or less novel aspect.

It has been for a long time customary, owing to the limited experience with vibratory currents, to consider an electric current as something circulating in a closed conducting path. It was astonishing at first to realize that a current may flow through the conducting path even if the latter be interrupted, and it was still more surprising to learn that sometimes it may be even easier to make a current flow under such conditions than through a closed path. But that old idea is gradually disappearing, even among practical men, and will soon be entirely forgotten.

If I connect an insulated metal plate P. Fig. 11, to one of the terminals T of the induction coil by means of a wire, though this plate be very well insulated, a current passes through the wire when the coil is set to work. First I wish to give you evidence that there is a current passing through the connecting wire. An obvious way of demonstrating this is to insert between the terminals of the coil and the insulated plate a very thin platinum or German silver wire w and bring the latter to incandescence of fusion by the current. This requires a rather large plate or else current impulses of very high potential and frequency. Another way is to take a coil C. Fig. 11, containing many turns of thin insulated wire, and to insert the same in the path of the current to the plate. When I connect one of the ends of the coil to the wire leading to another insulated plate P. and its other end to the terminal T1 of the induction coil, and set the latter to work, a current passes through the inserted coil C and the existence of the current may be made manifest in various ways. For instance, I insert an iron core i within the coil. The current being one of very high frequency, if it be of some strength will soon bring the iron core to a noticeably higher temperature, as the hysteresis and current losses are great with such high frequencies. One might take a core of some size, laminated or not, it would matter little: but ordinary iron wire 1-16 or 1-8 of an inch thick is suitable for the purpose. While the induction coil is working, a current traverses the inserted coil, and only a few moments are sufficient to bring the iron wire i to an elevated temperature sufficient to soften the sealing-wax s, and cause a paper washer p, fastened by it to the iron wire to fall off. But with the apparatus such as I have here, other, much more interesting, demonstrations of this kind can be made. I have a secondary S, Fig. 12, of coarse wire, wound upon a coil similar to the first. In the preceding experiment the current through a the coil C. Fig. 11, was very small, but there being many turns strong heating effect was, nevertheless, produced in the iron wire. Had I passed that current through a conductor in order to show the heating of the latter, the current might have been too small to produce the effect desired. But with this coil provided with a secondary winding I can now transform the feeble current of high tension which passes through the primary P into a strong secondary current of low tension, and this current will quite certainly do what I expect. In a small glass tube (t, Fig. 12) I have inclosed a coil platinum wire, w, this merely in order to protect the wire. On each end of the glass tube is sealed a terminal of stout wire to which one of the ends of the platinum wire, w, is connected. I join the terminals of the secondary coil to these terminals and insert the primary p, between the insulated plate P1 and the terminals T1 of the induction coil as before. The latter being set to work, instantly the platinum wire w is rendered incandescent, and can be fused even if it be very thick.

Instead of the platinum wire I now take an ordinary 50-volt 16-c. p. lamp. When I set the induction coil in operation the lamp filament is brought to high incandescence. It is, however, not necessary to use the insulated plate, for the lamp, (l, Fig, 13) is rendered incandescent even if the plate P1 be disconnected. The secondary may also be connected to the primary as indicated by the dotted line in Fig, 13. to do away more or less with the electrostatic induction or to modify the action otherwise.

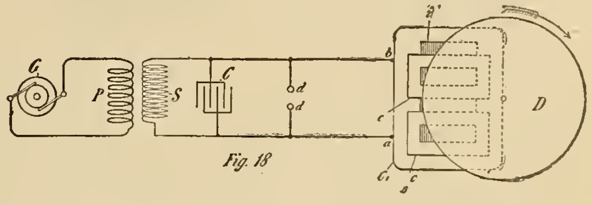


Fig. 18

OPERATING A MOTOR BY DISRUPTIVE DISCHARGES.

I may here call attention to a number of interesting observations with the lamp. First, I disconnect one of the terminals of the lamp from the secondary S. When the induction coil plays, a glow is noted which fills the whole bulb. This glow is due to electrostatic induction. It increases when the bulb is grasped with the hand, and the capacity of the experimenter's body thus added to the secondary circuit. The secondary, in effect, is equivalent to a metallic coating, which would be placed near the primary. If the secondary, or its equavalent, the coating, were placed symmetrically to the primary, the electrostatic induction would be nil under ordinary conditions, that is, when a primary return circuit is used, as both halves would neutralize each other. The secondary is, in fact, placed symmetrically to the primary, but the action of both halves of the latter, when only one of its ends is connected to the induction coil, is not exactly equal; hence electrostatic induction takes place, and hence the glow in the bulb. I can nearly equalize the action of both halves of the primary by connecting the other free end of the same to the insulated plate, as in the preceding experiments.

When the plate is connected, the glow disappears. With a smaller plate it would not entirely disappear, and then it would contribute to the brightness of the filament when the secondary is closed, by warming the air in the bulb.

To demonstrate another interesting feature, I have adjusted the coils used in a certain way. I first connect both the terminals of the lamp to the secondary, one end of the primary being connected to the terminal T^1 of the induction coil, and the other to the insulated plate P^1 as before. When the current is turned on, the lamp glows brightly, as shown in Fig. 14b, in which C is a fine wire coil and S a coarse wire secondary wound upon it. If the insulated plate P_1 is disconnected, leaving one of the ends a of the primary insulated, the filament becomes dark or generally diminishes in brightness (Fig. 14a). Connecting, again the plate P_1 and raising the frequency of the current, I make the filament quite dark or barely red, Fig. 15b. Once more I will disconnect the plate. One will, of course, infer that when the plate is disconnected, the current through the primary will be weakened, that therefore the E. M. F. will fall in the secondary S, and that the brightness of the lamp will diminish. This might be the case, and the result can be secured by an easy adjustment of the coils ; also by varying the frequency and potential of the currents. But it is perhaps of greater interest to note that the lamp increases in brightness when the plate is disconnected (Fig. 15a). In this case all the energy the primary receives is now sunk into it, like the charge of a battery into an ocean cable, but most of that energy is recovered through the secondary and used to light the lamp. The current traversing the primary is strongest at the end b, which is connected to the terminal T^1 of the induction coil, and diminishes in strength towards the remote end a. But the dynamic inductive effect exerted upon the secondary S is now greater than before when the suspended plate was connected to the primary. These results might have been produced by a number of causes. For instance, the plate P^1 being connected, the reaction from the coil C may be such as to diminish the potential at the terminal T_1 of the induction coil, and therefore weaken the curren through the primary of the coil C. Or the disconnecting of the plate may diminish the capacity effect with relation to the primary of the latter coil to such an extent that the current through it is diminished, though the potential at the terminal T^1 of the induction coil may be the same or even higher. Or the result might have been produced by the change of phase of the primary and secondary currents and consequent reaction. But the chief determining factor is the the relation of the self-induction and capacity of coil C and plate P_1, and the frequency of the currents. The greater brightness of the filament in Fig. 15a is in part due to the heating of the rarefied gas in the lamp by electrostatic induction, which, as before remarked, is greater when the suspended plate is disconnected.

Still another feature of some interest I may here bring to your attention. When the insulated plate is disconnected and the secondary of the coil opened by approaching a small object to the secondary, but very small sparks can be drawn from it, showing that the electrostatic induction is small in this case. But upon the secondary being closed upon itself or through the lamp, the filament glowing brightly, strong sparks are obtained from the secondary. The electrostatic induction is now much greater, because the closed secondary determines a greater flow of current through the primary, and principally through that half of it which is connected to the induction coil. If now the bulb be grasped with the hand, the capacity of the secondary with reference to the primary is augmented by the experimenter's body and the luminosity of the filament is increased, the incandescence now being due partly to the flow of the current through the filament and partly to the molecular bombardment of the rarefied gas in the bulb.

The preceding experiments will have prepared one for the next following results of interest, obtained in the course of these investigations. Since I can pass a current through an insulated wire merely by connecting one of its ends to the source of electrical energy, since I can induce by it another current, magnetize an iron core, and, in short, perform all operations, as though a return circuit were used, clearly I can also drive a motor by the aid of only one wire. On a former occasion I have described a simple form of motor, comprising a single exciting coil, an iron and disc. Fig. 16 illustrates a modified way of operating such an alternate current motor by currents induced in a transformer connected to one lead, and several other arrangements for circuits for operating a certain class of alternate motors founded on the action of currents of differing phase. In view of the present state of the art it is thought sufficient to describe these arrangements in a few words only. In the diagram, Fig. 16 II- shows a primary coil P, connected with one of its ends to the line L leading from a high tension transformer terminal T_1. In inductive relation to this primary P is a secondary S of coarse wire in the circuit of which is a coil c. The currents induced in the secondary energize the iron core i, which is preferably, but not necessarily, subdivided, and set the metal disc d in rotation. Such a motor M^2 is diagrammatically shown in Fig. 16 II., has been called a "magnetic lag motor," but this expression may be objected to those by who attribute the rotation of the disc to eddy currents circulating in minute paths when the core i is finally subdivided. In order to operate such a motor effectively on the plan indicated the frequencies should not be too high, not more than four or five thousand, though the rotation is produced even with ten thousand per second, or more.

In Fig. 16 I. a motor M_1, having two enegizing circuits, A and B, is diagrammatically indicated. The circuit A is connected to the line L, and in series with it is a primary P, which may have its free end connected to an insulated plate P_1, such connection being indicated by the dotted lines. The other motor circuit B is connected to the secondary S, which is in inductive relation to the primary p. When the transformer terminal T^1 is alternately electrified, currents traverse the open line L and also circuit A and primary P. The currents through the latter induce secondary currents in the circuit S, which pass through the energizing coil B of the motor. The currents through the secondary S and those through the primary P differ in phase 90 degrees, or nearly so, and are capable of rotating an armature placed in inductive relation to the circuits A and B.

In Fig. 16 III. a similar motor M_3 with two energizing circuits A^1 and B_1 is illustrated. A primary P. connected with one of its ends to the line L, has a secondary S, which is preferably wound for a tolerably high E. M. F., and to which the two energizing circuits of the motor are connected, one directly to the ends of the secondary, and the other through a condenser C, by the action of which the currents traversing the circuit A_1 and B_1 are made to differ in phase.

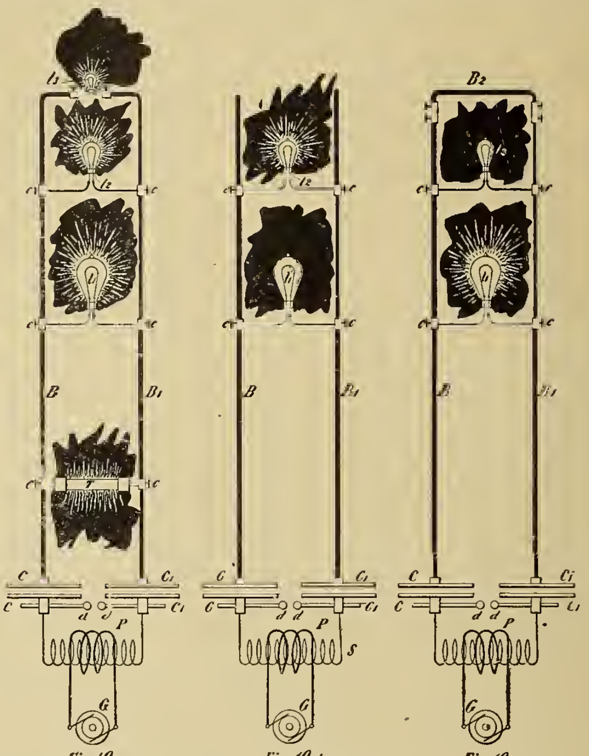


Fig. 19 a Fig 19 b Fig. 19 c

IMPEDANCE PHENOMENA.

In Fig. 16 IV. still another arrangement is shown. In this case two primaries P_1 and P_2 are connected to the line L, one through a condenser C of small capacity, and the other directlv. The primaries are provided with secondaries S_1 and S^2, which are in series with the energizing circuits A_2 and B_2, and a motor M_3 the condenser C again serving to produce the requisite difference in the phase of the currents traversing the motor circuits. As such phase motors with two or more circuits are now well known in the art, they are here illustrated diagrammatically. No difficulty whatever is found in operating a motor in the manner indicated, or in similar ways, and although such experiments up to this day present only scientific interest, they may at a period not far distant be carried out with practical objects in view.

It is thought useful to devote here a few remarks to the subject of operating devices of all kinds by means of only one leading wire. It is quite obvious that when high-frequency currents are made use of, ground connections are—at least when the E. M. F. of the currents is great—better than a return wire. Such ground connections are objectionable with steady or low frequency currents, on account of destructive chemical actions of the former, and disturbing influences exerted by both on the neighboring circuits; but with high frequencies these actions practically do not exist Still, even ground connections become superfluous when the E. M. F. is very high, for soon a condition is reached when the current may be passed more economically through open than through closed conductors. Remote as might

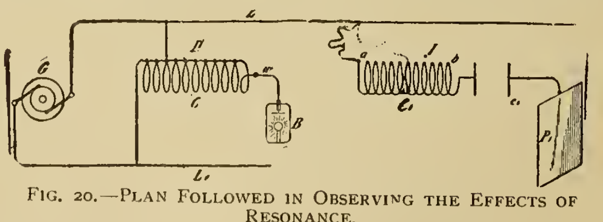


FIG. 20.—PLAN FOLLOWED IN OBSERVING THE EFFECTS OF RESONANCE.

seen an industrial applicant of such single wire transmission of energy to one not experienced in such lines of experiment, it will not seem so to any one who for some time has carried on investigations of such nature. Indeed I cannot see why such a plan could not be practicable. Nor should it be thought that for carrying at such a plan currents of very high frequency are implicitly required, for just as soon as potentials of, say, 30,000 volts are used the single wire transmission may be effected with low frequencies, and experiments have been made by me from which these inferences are made.

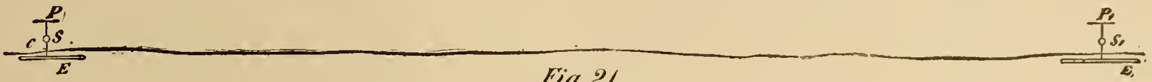


Fig. 21

ENERGY TRANSMISSION TO ANY DISTANCE WITHOUT WIRES.

When the frequencies are very high it has been found in laboratory practice quite easy to regulate the effects in the manner shown in diagram Fig 17. Here two primaries P and P are shown, each connected with one of its ends to the line L, and with the other end to the condenser plates C and C_1, respectively. Near these are placed other condenser plates C_1 and C'_1, the former being connected to the line L, and the latter to an insulated larger plate P^2. On the primaries are wound secondaries S and S^1 of coarse wire, connected to the devices m and d respectively. By varying the distances of the condenser plates C and C_1, and C^2 and C'_1, the currents through the secondaries S and S^1 are varied in intensity. The curious feature is the great sensitiveness, the slightest change in the distance of the plates producing considerable variations in the intensity or strength of the currents. The sensitiveness may be rendered extreme by making the frequency such that the primary itself without any plate attached to its free end satisfies, in conjunction with the closed secondary, the condition of resonance. In such condition an extremely small change in the capacity of the free terminal produces great variations. For instance, I have been able to adjust the conditions so that the mere approach of a person to the coil produces a considerable change in the brightness of the lamps attached to the secondary. Such observations and experiments possess of course at present chiefly scientific interest, but they may soon become of practical importance.

Very high frequencies are of course not practicable with motors on account of the necessity of employing iron cores. But one may use sudden discharges of low frequency and thus obtain certain advantages of high frequency currents without rendering the iron core entirely incapable of following the changes and without entailing a very great expenditure of energy in the core. I have found it quite practicable to operate, with such low frequency disruptive discharges of condensers, alternating current motors. A certain class of such motors which I advanced a few years ago, which contained closed secondary circuits, will rotate quite vigorously when the discharges are directed through the exciting coils. One reason that such a motor operates so well with these discharges is that the difference of phase between the primary and secondary currents is 90 degrees, which is generally not the case with harmonically rising and falling currents of low frequency. It might not be without interest to show an experiment with a a simple motor of this kind, inasmuch as it is commonly thought that disruptive discharges are unsuitable for such purposes. The motor is illustrated in Fig. 18. It comprises a rather large iron core i with slots on the top into which are imbedded thick copper washers c. c. In proximity to the core is a freely movable metal disc D. The core is provided with a primary exciting coil C, the ends a and b of which are connected to the terminals of the secondary S of an ordinary transformer, the primary P of the latter being connected to an alternating distribution circuit or generator G of low or moderate frequency. The terminals of the secondary S are attached to a condenser C which discharges through an open air gap d d, which may be placed in series or shunt to the coil C. When the conditions are properly chosen the disc D rotates with considerable effort, and the iron core i does not get very perceptibly hot. With currents from a high frequency alternator, on the contrary, the core gets rapidly hot and the disc rotates with a much smaller effort. To perform the experiment properly it should be first ascertained that the disc D is not set in rotation when the discharge is not occuring at d d. It is preferable to use a large iron core and a condenser of large capacity so as to bring the superimposed quicker oscillation to a very low pitch or to do away with it entirely. By observing certain elementary rules I have also found it practicable to operate ordinary series or shunt direct current motors with such disruptive discharges, and this can be done with or without a return wire.

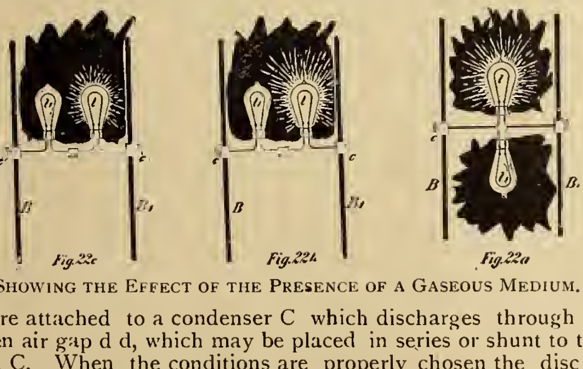
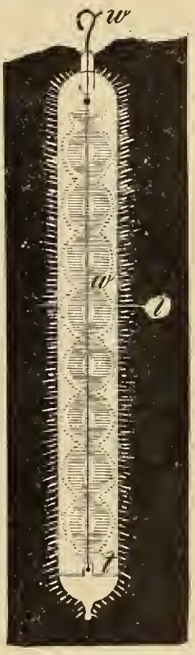


Fig. 22c *Fig. 22b* *Fig. 22a*

SHOWING THE EFFECT OF THE PRESENCE OF A GASEOUS MEDIUM.

Among the various current phenomena observed perhaps the most interesting are those of impedance presented by conductors to currents varying at a rapid rate. In my first paper before the American Institute of Electrical Engineers I have described a few striking observations of this kind. Thus I showed that when such currents or sudden discharges are passed through a thick metal bar there may be points at the bar only a few inches apart which have a sufficient potential difference between them to maintain at bright incandescence an ordinary filament lamp. I have also described the curious behavior of rarefied gas surrounding a conductor to such sudden rushes of current. These phenomena have been since more carefully studied, and one or two novel experiments of this kind are deemed of sufficient interest to be described here.

With reference to Fig. 19a B and B_1 are very stout copper bars, connected at their lower ends to plates C and C^1, respectively, of a condenser, the opposite plates of the latter being connected to the terminals of the secondary S of a high-tension transformer, the primary P of which is supplied with alternating currents from an ordinary low-freqeuency dynamo G, or distribution circuit. The condenser discharges through an adjustable gap d d as usual. By establishing a rapid vibration it was found quite easy to perform the following curious experiment: The bars B and B^1 were joined at the top by a low-voltage lamp l_3; a little lower was placed, by means of clamp c c, a 50 volt lamp l^2 and still lower another 100-volt lamp l_1 and finally at a certain distance below the latter lamp an exhausted tube T. By carefully determining the positions of these devices it was found practicable to maintain them all at their proper illuminating power. Yet they were all connected in multiple arc to the two stout copper bars and required widely different pressures. This experiment requires, of course, some time for adjustment, but is quite easily performed.



CURIOUS INCANDESCENCE OF A WIRE,

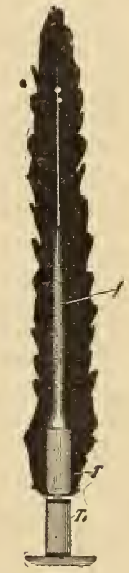


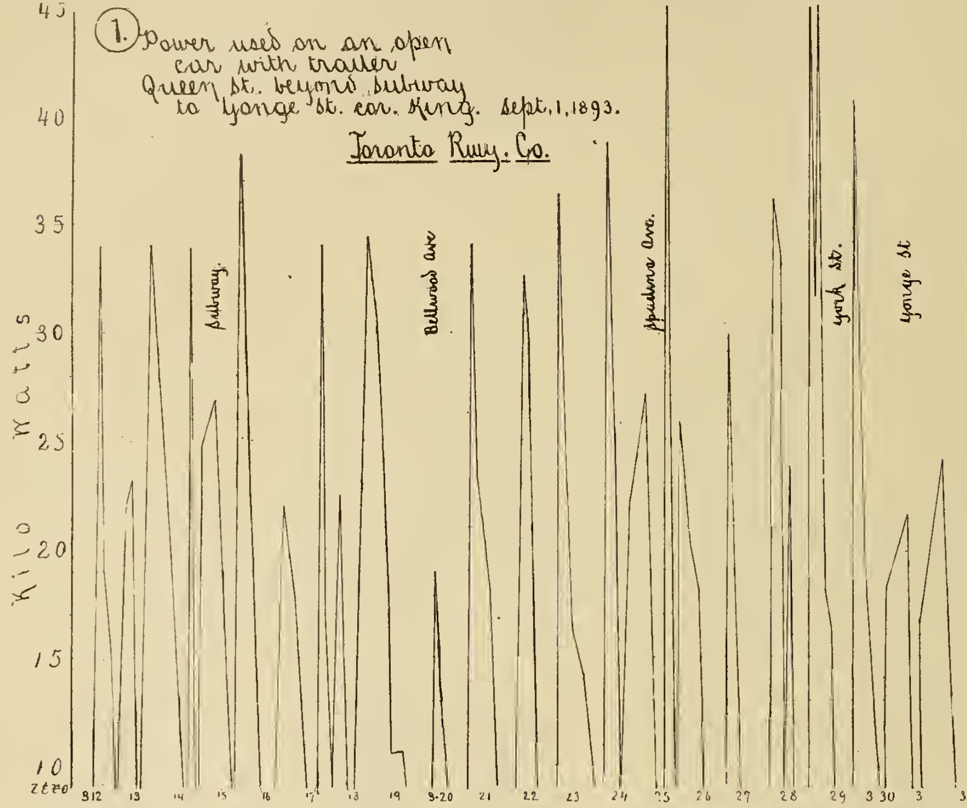
Fig. 25

ILLUSTRATING LATERAL DIFFUSION.

In Figs. 19b and 19c, two other experiments are illustrated which, unlike the previous experiment, do not require very careful adjustments. In Fig. 20b, two lamps l_1 and l_2, the former a 100-volt and the latter a 50-volt, are placed in certain positions as indicated, the 100-volt lamp being below the 50-volt lamp. When the arc is playing at d d, and the sudden discharges passed through the bars B B the 50-volt lamp will, as a rule, burn brightly, or, at least; this result is easily secured, while the 100 volt lamp will burn very low or remain quite dark, Fig. 19b. Now the bars B B may be joined at the top by a thick cross bar B^2, and it is quite easy to maintain the 100-volt lamp at full candle power while the 50-volt lamp remains dark, Fig. 19c. These results as I have pointed out previously, should not be considered to be due exactly to frequency, but rather to the time rate of change which may be great even with low frequencies. A great many other results of the same kind equally interesting, especially to those who are only used to manipulate steady currents, may be obtained, and they afford precious clues in investigating the nature of electric currents.

In the preceding experiments I have already had occasion to show some light phenomena, and it would be now proper to study those in particular; but to make this investigation more complete, I think it necessary to first make a few remarks on the subject of electrical resonance, which has to be always observed in carrying out these experiments.

(To be Continued.)



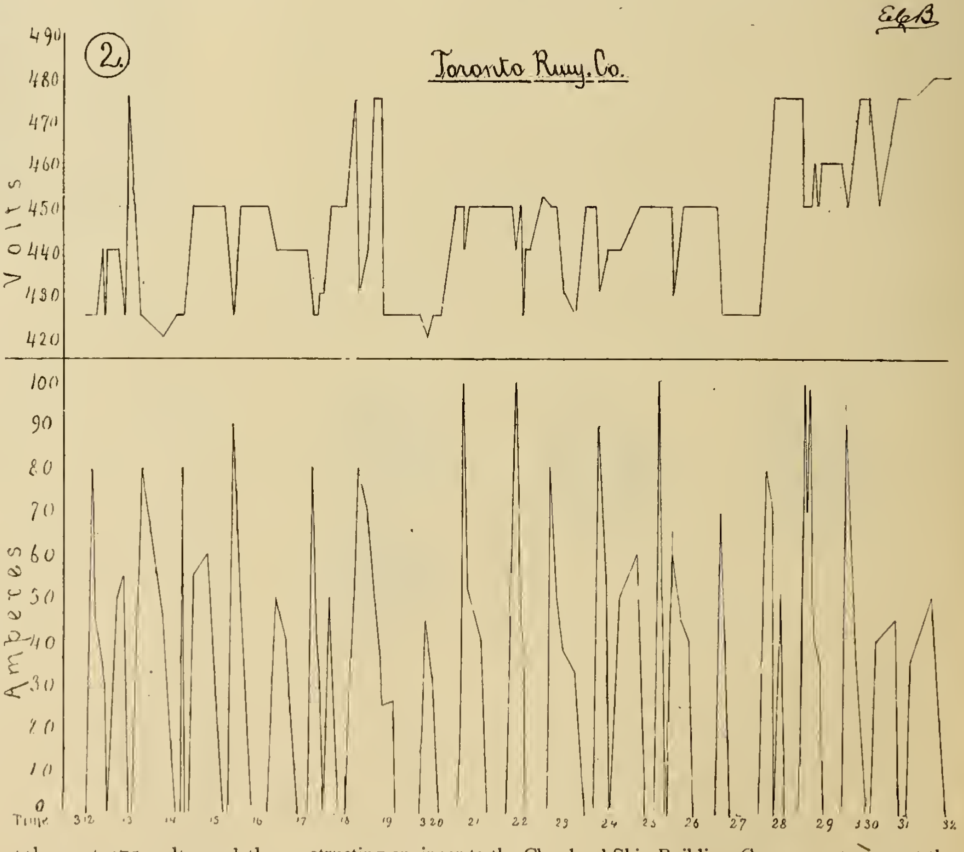
POWER CURVES.

E. CARL BREITHAUPT.

The accompanying power curves were presented before the last meeting of the Canadian Electrical Association in connection with a paper on Street Railways, and were intended especially to show the extreme variations in the duty required of a street railway motor. The readings were taken on a regular run of one of the cars of the Toronto Street Railway Co., drawing an open trailer on the Queen St. line.

The curves show the results obtained on the return trip, up Queen Street, from Lansdowne ave. to Yonge street, thence down Yonge to King street, a distance of about three miles. The total time was 19 minutes 50 seconds, thus showing an average speed of about nine miles per hour, including stops.

The trolley is No. 00 hard drawn copper wire, fed at Spadina Ave. and at the Subway by No. 0000 feeders. The roadbed is practically level with the exception of two short but sharp grades at the Subway. The number of passengers carried varied from 15 to 30, averaging about 30, and the readings at the motor terminals indicated a very quick and wide variation in the amount of power supplied to the motor, twice reaching a maximum of 45 Killowatts; this was on starting at Spadina Ave., when there were fifty passengers on board, and again on starting near York street. In both cases the readings were only momentary. At the Subway the number of passengers was fifteen and the maximum reading on the up grade was only 27 Killowatts.



The voltmeter readings did not vary much. The maximum can be taken at 475 volts and the minimum at 425 volts, though 420 volts was twice indicated; the total variation was therefore only 11 per cent. of the mean voltage, which, considering the fact that the feeders are over one and one-half miles apart, must be considered very satisfactory.

The power house is equipped with four Armington & Sims high speed, compound condensing engines, each rated at 600 hp. at one quarter stroke and each belted directly to two Edison 200 K.W. generators. The total load as indicated at the station was very steady, showing a fluctuation of not over 5 per cent. during several hours. This goes to prove an assertion which was made in the paper above referred to, viz., that on a road where a large number of cars are operated, the fluctuations observed on the separate cars, tend to equalize each other and the consequent variation of the total load from minute to minute is therefore only a small one. The total load will of course be greater or less during certain hours of the day when traffic is exceptionally heavy or light.

Curves of this kind are always instructive, and they should be taken at regular intervals in every electric plant, especially where losses may occur which are not easily detectable; they show a full analysis of what is going on, where and how the the power generated at the central station is being expended.

Berlin, Nov. 22nd, 1893.

PERSONAL.

Mr. H. P. Dwight, manager of the Great Western Telegraph Company, is on a visit to the North-West.

Mr. A. E. Edkins, Prov.-Deputy of the C. A. S. E., will sail from New York for England on the 6th inst., having obtained six weeks' leave of absence for the purpose of spending the holiday season with relatives in the old land. We wish him *bon voyage*.

Mr. J. B. Griffith, manager of the Hamilton Street Railway, has just returned from an extended visit to California, and reports himself greatly improved in health.

Mr. J. H. Killey, the well-known engineer, of Hamilton, Ont., has been appointed consulting engineer at London, Ont., to the Steam Boiler and Plate Glass Insurance Company of that city.

Mr. Arendt Angstrom lately resigned his position of architect and constructing engineer to the Cleveland Ship Building Company, to accept the position of general manager of the Bertram Engine Works Company, Toronto.

An electric railway between Welland and Fonthill, to be used for the carriage of fruit and passengers, is talked of.

MONTREAL ELECTRIC CLUB.

Nov. 6th.—Besides other business, the following officers were elected to fill vacancies for the balance of the year: vice-president, H. W. Woodman; treasurer, L. M. Pinolet; committee of management, H. Ritchie, R. W. Herring and Jas. Douglas. Mr. R. W. Herring then read his paper on "Steamboat Lighting by Electricity." Some interesting remarks by Mr. J. C. Gough on the importance to the electrical engineer of a knowledge of steam engineering, brought the meeting to a close, votes of thanks being given to Mr. Herring for his paper and to Mr. Gough for his talk.

Nov. 20th.—After the transaction of business, Mr. J. C. Gough read a paper on "The Philosophy, Application, Construction and Improvement of the Steam Engine," which was listened to with much attention and led to considerable discussion. A vote of thanks was given Mr. Gough for his interesting paper.

Mr. W. B. Shaw, President of the Montreal Electric Club, whose portrait is herewith presented, was born at Saltcoats, Ayrshire, Scotland. He came to Canada about fifteen years ago, since which time he has resided in Montreal, having completed his school days at the High School in that city. After leaving school Mr. Shaw entered the employ of Mr. Binks as book-keeper, and while thus engaged, occupied his leisure hours with the study of electricity. His first experience at practical work was gained with Mr. H. T. Hibbard, after whose unfortunate failure he took a position as electrician with Mr. T. W. Ness, which he held for three years, resigning to go as assistant to Mr. Starr, general agent of the Royal Electric Co. On the first of May last, in company with his brother, Mr. John Shaw, and Mr. Walter F. Taylor, the Montreal Electric Company was organized, and he entered into business on his own account.

W. B. SHAW,
President Montreal Electric Club.

THE BELL TELEPHONE COMPANY'S FACTORY, MONTREAL.

A REPRESENTATIVE of the ELECTRICAL NEWS was recently afforded the opportunity of making an inspection of the large manufactory of the Bell Telephone Company on Aqueduct Street, Montreal, in which is manufactured most of the apparatus and supplies required in the Company's business, and offered to purchasers through its Sales Department. The factory comprises two buildings, each 150 x 50 feet in size, and being connected only by an iron passageway. The front building is three stories in height and the rear building two stories. The buildings have a frontage of 150 feet on Aqueduct street. They are constructed of brick on a foundation of masonry, and are designed in such a way as to offer but little inflammable material as food for fire. In addition every precaution has been exercised for their protection should a fire occur. A fire pump, situated in the boiler room, is connected with a 25,000 gallon tank as well as with a hydrant on a pipe connected with the city mains, so that if by chance the pressure from the city mains should fail, the tank would afford the requisite pressure. The fire pump has a capacity of 500 gallons per minute, for which a pressure of 40 pounds per square inch is maintained on the boilers at night.

The first floor of the front building is occupied by the offices of the Superintendent, Mr. C. W. Brown, clerks and draughtsmen, machine shop and tool manufactory. The machine tools are of the lighter order, and are mostly employed on brass-work. Several of the machines here seen have no counterpart in Canada, as for example one which is fitted with 24 drills and can bores 24 holes at one operation.

On the next floor is the assembling room, where the parts composing the various kinds of apparatus are put in their proper positions. Here is being put together the new switchboard for the Toronto Exchange which it is expected will be completed early in the new year. Any attempt at a description of this board is deferred until a later date, but it may be stated that without having examined the nature of its construction it would be difficult if not impossible to conceive of the infinitude of its parts and the immense amount of skill, care and labor involved in it. The manufacture of this board has been proceeded with deliberately with the object of embodying in it the very latest improvements, and this determination has necessitated a number of changes since the undertaking began.

From the wire covering department is turned out about 1000 lbs. of covered wire per month, most which of is consumed in the the Company's business. This is easy to understand when it is remembered that every set of telephone instruments contains half a mile of wire. Some of the wire seen on the covering machines measured only 5-1000ths of an inch in thickness. On this floor there is also the Inspection Department, where every instrument is tested before leaving the factory.

In the basement are the Storage and Shipping Departments, the manufactured articles being lowered from the various floors by a hoist. Here are quantities of materials of almost every description, for use in the manufactory and in the various branches of the company's business throughout the country, for all of which this is the headquarters of supply. Scores of boxes of magneto bells, and miles of cable and wire are here stored; also vulcanized fibre, the product of the Vulcanized Fibre Company's factory at Wilmington, Del., for insulation in dry places, and sheets of hard rubber to be similarly employed in damp positions. Enquiry as to the life of iron wire brought the reply that in cities where it is subjected to an atmosphere impregnated with gases of various kinds, its duration is only about three years, and in sea-side towns, such as Halifax, the influence of the salt-air is such as to destroy iron wire in about six months. For this reason, it has been found more profitable in such a location to use phosphor bronze wire, the greater first cost being more than repaid by its enduring quality.

The rear building contains a department in which are manufactured all the batteries used in the Bell instruments throughout Canada. There is one thing connected with these batteries which it is a matter of regret to learn has not been procurable in Canada thus far, namely, the porous earthenware cups, of which 10,000 per year are imported from the Northwestern States. The manufacture of these cups is being experimented upon, and it is hoped that shortly their successful production will be achieved. This building contains also a lumber store-room and dry kiln, and a wood-working shop where all the cabinet work connected with the instruments, switchboards, etc., is made, as well as the cable boxes and cross arms. Of the latter there will be turned out 50,000 this year. There is also a nickel-plating department, buffing room, brass foundry, and engine room. The latter contains a 125 h. p. Corliss engine, manufactured by Laurie Bros., operated by two 100 h. p. tubular boilers located in a detached building near by. The engineer in charge gives it the best of attention.

The factory throughout is systematically arranged with a view to economy and efficiency of operation. Cleanliness and order are everywhere apparent. The number of regular employees is about 200. The Company find that their manufacturing capacity must shortly be increased, and contemplate increasing the height of their factory in order to provide the additional room required.

Mr. Brown, who exercises such efficient oversight of this department of the business, has grown up from a boy with the Company's business, having been employed in the factory in Boston, where the experimental work was done on the first Bell telephones.

The annual report of the Electric Light Department of the City of New Westminster, B. C., shows that at the beginning of the year there was a deficit of $4,000, but during the last three months, the department not only made their charges, but earned a small margin of profit. The extension of the system, however, has necessitated considerable expenditure, and this with the deficit on hand at the commencement of the year, leaves the department at the close of the year with an overdrawn account of $12,000. Additional expenditure will be necessary for the further extension of the works to meet the demands for incandescent light. For this purpose these four plans are proposed:—1. To remove the present office, purchase an additional engine and another 1,500 light dynamo and, perhaps, a half-arc machine at an estimated cost of $3,000. 2. To buy a portion of the lot on the north side, extend the present building in that direction and increase the lighting capacity to 3,650 at a cost of from $15,000 to $20,000. 3. To purchase the lot on the south side and erect a building 33 feet wide and increase the capacity to 5,000 at a cost of from $20.000 to $25,000. 4. To purchase the lot on the south and erect thereon a 66 ft. building and increase the capacity to 12,000 at an estimated cost of $25,000 to $30,000. If proper additions are made to the plant it is estimated that the income can be increased by $1,000 per month. Mr. P. Bowler is the City's electrician.

CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

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WE wish to state to readers of the NEWS that our columns are open for questions of general interest on Electrical and Engineering topics, and would request all our readers to make use of them for this object, when we will do our best to furnish suitable replies.

THE life of the English patent on the Edison incandescent lamp expired on the 10th of November. The Canadian patent will expire on the 19th of November next year, at which time it is believed the term of the American patent will likewise end, but on this point there seems to exist some uncertainty.

Water is in the wrong place when it gets inside the steam cylinder. If boiler primes, water will be sure to come along with the steam, but it may be separated by having steam pipe carried past the cylinder, and a branch at right angles to convey the steam. The steam will turn the corner, and the water pass straight on.

SOME Toronto friends we hear are thinking of getting together for social and educational purposes an Electric Club, similar to that in vogue in Montreal. We understand that the Montreal Club have at one of their late meetings adopted a new set of by-laws and constitution, which we presume will be forwarded to any inquirer by any of the Club's officers.

WITHIN the past fortnight a successful test has been made on the Erie canal of the adaptability of the trolley system for the propulsion of canal boats. It is expected that the substitution of electricity for animal power for this purpose will be the means of reducing by one-half the cost of propulsion. Another effect will be to restore to a considerable extent competition between water and rail freight transportation.

A STRANGE fact has been brought to light by Prof. Cahart while experimenting in arc lighting, viz., that with constant watts in an arc we may obtain very different candle powers by varying the current and pressure inversely, still keeping the watts, however, constant. With 450 watts and using a current of 8.4 amperes he procures 900 c. p. On raising the current to 10 amperes at 45 volts he only gets 450 c. p. A 500 watt arc, therefore, gives more light (*i. e.*, 950 c. p. with 9 amperes at 55 volts), while with 45 volts 11 amperes, only 500 c. p. is produced. This is an item which has been discussed by various Canadian electrical men before this, and Prof. Cahart's researches will in all probability settle some of the disputed points.

SOME time ago the utilization of the power of the Lachine Rapids at Montreal was spoken of. Upon finding the numerous difficulties which would be involved in such an undertaking, not to speak of the fact that the water runs up hill there during a flood at Montreal, the scheme was dropped. Apparently also is the project of the Royal Electric Co., of Montreal, to bring power from the Chambly Rapids on the Richelieu River. The Hurontario Canal which is to supply power for electrical purposes, will probably end up in like manner. This in some measure bears out the statements made by many intelligent electrical engineers that a good economical and well made steam engine, where coal is at a fair price, is more to be depended on and in the long run is probably as cheap as water power.

SINCE the regrettable accident to the Rev. Mr. Botterell in Montreal, the Montreal Street Railway Co. have been running their cars at a decidedly slower rate in response to the clamor of the general public. The accident was certainly one to be regretted, but there is no reason for the clamor to have the car service run at such a speed that it is impossible for business men in Cote St. Antoine having but one hour for dinner to go home there and get it. We venture to state that the old horse car system produced more accidents to the week than the electric system has done per month since its inauguration. When the horse car system was in use, the cry was "rapid transit"; when rapid transit was given, the cry was "too quick," but it is ever thus.

A pump is said to lift water. This phrase often leads to a misconception of the true working of a pump. There are pumps which lift water, but they are not usually found in connection with steam boilers. The ordinary plunger pump "lifts water" by producing a vacuum in the chamber of the pump, and the pressure of the atmosphere then forces water into this space. The man who gets a clear idea of this operation, will know that if the pump is not getting water, he must look out for one or other of four defects: 1st. He will see that the packing of the pump gland is right, so that the plunger may form the vacuum. 2nd. He will see that the valves are in place and free to open and shut. 3rd. He will look out for any air leaks or obstructions in suction pipe. 4th. He will make sure that there is water to lift within lifting distance from the pump.

IT seems strange to us that with the many really good constant potential arc lamps on the market, even for 52 volt alternating current, that there are not more of them used in place of incandescent lights. Taking a current of 10 amperes we only get (on 52 volt alternating circuit) 160 c. p. in all. For the same current expended through an arc and its accompanying rheostat we get about 1200 c. p. This at ¾ cent. rate would cost us 7½ cents per hour to burn. On the other hand to obtain the same candle power from incandescent lights we should require to burn about eighty 16 c. p. lights, which would cost 60 cents per hour. Stations which are heavily loaded and have no room at present for extension, would do well to advocate these lamps, as they would be certain to give satisfaction in many places.

IN the ELECTRICAL NEWS for November there appeared a letter from Mr. D. W. Robb, of Amherst, Nova Scotia, on the relative merits of high versus slow speed engines for electrical purposes. The writer argued the case on behalf of the high speed engine with ability and fairness. A rejoinder to Mr. Robb appears in the present issue from the pen of Mr. W. T. Brown, of Galt. The subject is an interesting one, and might profitably be further discussed, and for this object our columns are at the disposal of readers who may desire to give their experience or express their views. Another subject which is engaging considerable attention at present is the relative advantages of horizontal and vertical compound engines. The Toronto Electric Light Company and the Royal Electric Company have recently installed large new engines of the vertical type, and express the opinion that they are the engine of the future, while on the other hand in the new power station of the Montreal Street Railway Company, horizontal engines are to be employed, and a well-known engineering expert of that city in conversation with the writer gave it as his opinion that the weight of advantage was on the side of the horizontal engine. What do our readers think about it?

AT the annual meeting of the Montreal Street Railway Company, it was announced that the franchises for the construction of electric railways in the suburbs of St. Cunegonde and St. Henri, had been purchased by the Board of Directors for the sum of $50,000. This is an illustration of the means by which a number of speculators in Montreal will achieve wealth without the expenditure of effort which is usually necessary for that purpose. For several years past these speculators have been at work with the object of securing franchises from suburban municipalities for the construction of railways, the supply of water, power, etc. There never was any intention on the part of these men to construct the works, but they foresaw that in a very short time these municipalities would be annexed to the city and then they would be in a position to sell their franchises to the city or city corporations, at handsome prices. The purchase by the Montreal Street Railway Company is the first of the harvest which these speculators will sooner or later reap. The statement was made by one of the directors of the Company, that had the matter been brought before the Legislature, these franchises would have been annulled. There is a lesson here for the City of Toronto in dealing with the the Georgian Bay Canal scheme. It has been clearly shown that the object of the promotors of this scheme is to secure this valuable franchise and sell it to the highest bidder. We have the word of certain parties that they would be willing, in the event of this franchise being secured, to pay $100,000 in cash for it.

THE annual meeting of the Montreal Street Railway Company was held at the Company's offices in Montreal, on the 8th of November. The president, in his address to the stockholders, gave some information regarding the operation of the road, which will doubtless be of interest to railway managers. The receipts of last year show an increase of 30.02 per cent over 1892, and 52.63 per cent over 1891. The number of passengers carried in 1893 was 17,177,952, as compared with 11,631,386, in the previous year, and 9,837,257 in 1891. After paying into the city treasury 4 per cent of the net earnings, amounting to $28,365.96, the company netted a profit of $116,032.86, as against $93,980.21, in 1892. The expenses amounted to 17 cents per car mile, and the management was subjected to criticism on this point. It was, however, pointed out by the president that the high rate of expense this year was due to the disadvantageous conditions under which the system was operated, owing to the changing of the system and improvement of the roadbed and pavements, necessitating the use of both horses and electricity, as well as to the fact that the company, pending the completion of their new power station, were compelled to rent the necessary power at a price considerably higher than it is expected it can be produced by their own plant now being installed. It is estimated that when the conversion of the road is completed and the power station in operation, the expense per mile will be reduced from 17 to 12 cents. Fault was found by some of the shareholders with the action of the managent in giving to Messrs. Ross and Mackenzie, without competition, the contract for the construction work at $30,000 per mile. It was however, pointed out by the president that the work was given in this manner owing to the fact that the company were obliged to have a certain number of miles of road built within 60 days. It was also pointed out that the price at which the work was being done compares favorably with the cost of similar work in other cities, Cleveland and Toronto, for example, where the cost was $35,000 per mile. Mr. Ross, one of the contractors, stated that he had offered to relinquish his contract at any time that the company might desire. These explanations appeared to be satisfactory to those who had objected to this feature of the company's management, and the old board of directors was re-elected. The company was also authorized to make application to the Legislature for amendments to its charter and for power to increase the capital stock to $5,000,000. Mr. H. A. Everett, managing director of the road, has tendered his resignation, on the ground that his connection with the street railways of Cleveland and Toronto demands all his attention. Mr. G. C. Cunningham has been appointed as his successor.

The proposition made to the city Council of Belleville, by the Canadian General Electric Company, for the construction of an electric street railway in that city, is meeting with favorable consideration.

NOTES FOR ENGINEERS.

What makes an engine pound? If the question were put the other way—what will prevent an engine from pounding? it would to some be more reasonable. Pounding however, asserts itself, and speaks out so that a man who is no engineer will know something is wrong, and will be ready to ask what makes that pounding?

Sometimes the cause is in the steam cylinder. Anything loose about the piston or its connection to the piston rod will cause a knock. A little wear of the cylinder when the counter bore has not been made deep enough, and a little ridge forms, upon which the piston strikes as it comes to the end of the cylinder. Sometimes the counter bore is too deep, and the piston rings spring out as they reach it, where the piston is made with narrow rings.

Any of these causes are comparatively easy of discovery by an experienced man. The pounding may all be in the crank shaft bearing. If it is not exactly true and level or square to engine, there will be pounding as it revolves. The crank pin will certainly be affected in that case, and will give trouble from heating or cutting. The crosshead connection and slides are sometimes the cause because of not being quite true and fair with the cylinder and motion of the piston. In other cases every bearing may be perfectly true and fair, and yet engine will thump and pound as if trying to break itself up.

If the engineer finds all as true and fair as should be, and yet the pounding continues, he should get engine indicated and have diagrams studied by someone accustomed to the problem of valve setting.

It is necessary for successful running of an engine,that all the bearing surfaces be sufficiently slack to allow oil to flow in between them. When piston is moving forward, the slack is on the opposite side of the bearing from what it is when the dead centre is passed and piston is moving in the opposite direction. If the weight of the moving parts and the counter balances be adjusted to the speed if engine and pressure of steam, there should be no pounding, but in many cases it is necessary to set valve so as to cushion a little either with exhaust steam or with live steam, so as to take up the slack before the dead centre is passed. Each engine has to be studied and valve set so as to give the required amount and no more.

QUESTIONS AND ANSWERS.

M. L. D., Toronto, asks: Can you give me the name of a Canadian firm who manufacture glass insulators?

ANS.—We are unable to give the desired information, and would feel obliged if some of our readers would do so.

"W. N.," Hamilton, Ont., writes:

(1) Will you explain in your next number, the way to put a dynamo right when it has changed its current, that is when the current is reversed? also (2) the best and nearest place to get books treating on electricity and electrical machinery?

ANS.—If the dynamo is an arc machine, and it is necessary to change the current in a hurry owing to the lower carbons in lamps being in danger of burning out too soon, the trouble can be temporarily overcome by reversing the plugs on the switchboard, i. e.. if it is a T. & H. plant; turn each plug upside down on switchboard, so that the current enters the line from machine where it ordinarily returns. To make the polarity of machine right, take off brushes from commutator, or you will convert dynamo into a motor, and take a positive and negative wire from another dynamo in operation, and attach the live positive wire to the negative binding post of machine to be changed, and attach the negative live wire to the positive binding post, and allow current to pass through a few moments. The machine will then be found to be right polarity. (2) You may obtain through the ELECTRICAL NEWS any electrical books, by stating what books you require.

"Induction" asks: 1. Would you kindly inform me through your valuable paper where, and at what price I can obtain a book that will give me practical information on transformer construction and winding? 2. What metal would make a good core for a transformer, and where can it be obtained? 3. Is there any duty on burned out incandescent lamps, going into the United States. 4. Have you ever noticed that the customs charges on 1st and 2nd quality carbons, are the same, viz. $2.50 per m.? This is not as it should be, as it means 50 per cent. on the 2nds.

ANS.—1. "Transformers" by Caryl D. Haskins, published by the Bubier Publishing Co., of Lynn, Mass. Sold by electrical supply houses in Montreal at $1.25. 2. The metal must be iron. If a small transformer, annealed iron wire will do; if large enough to warrant it, discs cut or punched out of soft sheet iron with piece of tissue paper pasted on one side. Any hardware merchant can procure you the above. If the iron or iron wire be too hard it can be softened by heating to a bright red and laying it embedded in ashes afterwards to cool slowly. 3. There is no duty on goods sent back to the United States marked "For Repairs". The case, however, must be examined by the appraiser at the Examining Warehouse before export, so that it can be identified when returned. 4. Customs Tariff, Department No. 545, Act No. 207 C, reads: "Electric arc light carbons or carbon points not exceeding 12″ long, $2. 50 per 1,000, and in proportion for greater or less length." We should judge by this that the duty is the same for both qualities.

Jos. Ogle, Brantford, writes: Enclosed you will find a rough sketch of a heating system of our factory, supposed to be heated by exhaust steam from a Wheelock engine 16″x38″, developing 81 h.p., cutting off at ¼ stroke, having a 6″ exhaust pipe. After exhausting through heater there is a 4″ main running through engine room wall, which acts as a header, from which five ¼″ pipes are run all around the factory, returning to starting place, with 4 feet of a fall, and having a 2″ drip pipe at end. The system is overhead and 12 feet from the floor. I find we cannot do justice to the factory in heating it without having too much back pressure on engine (which I consider very expensive heating) also an abundance of steam escaping through back pressure valve to the open air. Would you recommend any change?

ANS.—In first place his 6″ exhaust from engine has an area of 28·27 sq. in. and is reduced to 4″ beyond heater which has an area of less than one half the 6 in. pipe; a reduction then takes place again to six ¼″ radiating pipes with a combined area of 7·362 s.q. in, and to make matters worse a 2″ drip is placed at end of pipes. The back pressure on engine is due to your not having area sufficient in your heating pipes. Then again your exhaust steam has to travel about 446 feet after it leaves the exhaust main, and supposing it has a temperature of 212° when leaving the engine (it should not be higher) it is very likely that it is condensed about the time it gets half way round. To overcome the difficulty, we would suggest that you cut the pipes running round factory in about the center and put in two headers each having a 2″ return drip, which you can run to your tank or whereever you like. Then run a 4″ pipe from above your present 4″ main and attach it to what is now the return end of your coil, thus making two separate coils. Of course it will be necessary to give the pipes the necessary fall to the return end. If an exhaust heating system is properly constructed and has sufficient area there should be no back pressure on engine at all; in fact there should be partial a vacuum.

MOONLIGHT SCHEDULE FOR DECEMBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1......	P. M. 50.0	A.M. 2.30	9.30
2......	" 5.00	" 3.30	10.30
3......	" 5.00	" 4.30	11.30
4......	" 5.00	" 5.30	12.30
5......	" 5.00	" 6.10	13.10
6......	" 5.00	" 6.10	13.10
7......	" 5.00	" 6.10	13.10
8	" 5.00	" 6.10	13.10
9......	" 5.00	" 6.10	13.10
10......	" 5.20	" 6.10	12.50
11......	" 6.20	" 6.20	12.00
12......	" 7.20	" 6.20	11.00
13......	" 8.30	" 6.20	9.50
14......	" 9.30	" 6.20	8.50
15......	" 10.40	" 6.20	7.40
16......	" 11.00	" 6.20	7.20
17......	" 11.40	....	6.40
18......	....	" 6.20	
19......	A.M. 12.50	" 6.20	5.30
20	" 2.10	" 6.20	4.10
21......	" 3.20	" 6.20	3.00
22......	No light.	No light.	....
23......	No light.	No light.	....
24......	No light.	No light.	....
25......	P. M. 5.10	P. M. 8.50	3.40
26......	" 5.10	" 10.00	4.50
27......	" 5.10	" 11.10	6.00
28......	" 5.10	A. M. 12.20	7.10
29......	" 5.10	" 1.20	8.10
30......	" 5.10	" 2.20	9.10
31......	" 5.10	" 3.20	10.10
		Total,	247.50
		Grand Total,	2,155.50

The Canadian General Electric Company put in successful operation a few days ago their new incandescent light system at London, Ont.

The Canadian Locomotive and Engine Co., of Kingston have recently manufactured for the School of Practical Science, Toronto, a solid fly wheel 4 felt in diameter and weighing 1650 lbs. This wheel has been placed on a dynamo countershaft which makes 450 revolutions per minute. Thus, the wheel has a periphery velocity of 5,900 revolutions Owing to the irregular working of the gas engine used to operate the laboratory machinery, the speed of the countershaft to which this wheel has been attached was formerly subject to sudden variations up to 20 per cent. rendering the use of the electrical recording instruments by the students impossible. By the use of this fly wheel the difficulty has been almost entirely overcome, the greatest fluctuation in speed at present being 3 per cent., and this occurring less suddenly than formerly.

STEAMBOAT LIGHTING BY ELECTRICITY.

By R. W. Herring.

The lighting of steamboats by electricity is now a very common and ordinary thing, but the time was, and not very long since, when the first steamship fitted with an electric light plant was a great marvel. This was about thirteen years ago, when the steamship Columbia, of the Oregon Railway & Navigation Co., was so lighted. It appears that in 1879 the president of the company, Henry Wellard, conceived the idea of lighting every room on board the steamer Columbia by electricity. By his orders and under suggestions from Mr. Edison himself, Mr. J. C. Henderson, then advising engineer of the Oregon Company, wired the new steamship, using No. 11 for mains and No. 32 wire for branches, the wire used being Underwriters double cotton covered, paraffined and painted all over.

The plant consisted of four dynamos, one of which was run as an exciter for the others. All of these machines were driven from a countershaft directly overhead, the countershaft being belted to a pair of vertical engines at a very high angle in order to economise space.

The first lamps used were of the paper carbon variety, and were found to be very irregular in their duration of life and so liable to breakage by heavy shocks that it was found best to suspend them directly from the wires above and do away with sockets entirely. The lamps being surrounded by a ground glass globe the attachment was hidden entirely, the lights being suspended from the ceiling. Later on these lamps were replaced by bamboo carbon lamps—these gave much better satisfaction. It was some of the experiences on board the Columbia that led to the introduction of safety valves.

This plant is described in one of the old Edison bulletins as being the first plant ever put in operation in the hands of strangers.

The only plant that could compete in the art was that built for the unfortunate exploring steamer Jennette, now lying at the bottom of the Arctic Ocean.

Since the plant was thus put on the S. S. Columbia, hundreds, and I might say thousands, of boats have been equipped with the electric light.

The great advantages to be gained by the electric light are, first, that of economy, inasmuch as it does not require the services of an attendant to trim and light the lamps. There is also much less expense for breakage; besides it is much cheaper than oil. I might here say that the quantity of oil used for lighting purposes only on some of the largest steamers, will average nearly two barrels per week. The next very important point is that of safety from fire, as no matches are required, and all danger of explosion from coal oil lamps is overcome, and there is no necessity to keep the doors and windows closed to keep the lamps from smoking the chimneys or from being blown out. The electric light is also perfectly clean and does not give off any unpleasant odor as is the case with lamps or candles. This alone is a great advantage, especially in rooms where passengers are sea sick.

All this is true, but the incandescent light has so thoroughly gained the day that argument has no longer to be made on these lines; in fact there is no need to make any argument at all for a first class passenger steamer not equipped with electricity is something to be considered far behind the times.

Now, as I am directly interested in this particular branch of electric lighting through my connection with the Richelieu and Ontario Navigation Company, I will endeavor to give you a brief description of a few of the different plants under my charge.

First, I will mention that of the steamer Carolina, which was purchased by the company and brought on here from Baltimore last spring. This plant was installed, I should say, aboutt five or six years ago. It consists of a 250 light Edison dynamo of the type usually built at that time, belted directly to a 30 h. p. Armington & Sims High Speed Engine. The mains which consisted of a pair of No. 2 Okonite wires running direct from the machine to the ceiling and there soldered into two pair of No. 4 wire, one pair running forward and one aft through a bank of branch cut-outs; from these cut-outs branches were run in moulding to all the different parts of the boat, the dynamo room being situated almost midship, it was a very good point of distribution.

There was no switchboard or instruments of any description excepting the Rheostat. The main saloon is lighted by one elegant sixteen light electrolier which is nicely fitted with six oil lamps for use in case of emergency; there are also one four and one six light fixture besides numerous side brackets which give a very fine effect. The saloon forward is also very nicely lighted after the same style. The dining saloon is lighted by a very neat two light combination fixture over each table. The ladies' cabin is also well lighted. There is also a light in each stateroom, in all passages, washrooms, lavatories, etc. The wires running to these single lights are soldered on to the mains in the moulding and coming out one side passing through a single pole fuse block and then down to a vamp switch and up to the light which is on the ceiling, the other wire running direct from the main to the light. The wire used for these small branches was No. 18 Habershaw, and was stapled in grooves cut in the woodwork, which when painted made a very neat job, but hardly in accordance with our wiring rules of to-day. Each socket was attached to the ceiling with a small spiral brass spring, which greatly relieved the lamp from the vibration of the boat. They also used electricity for the mast head and side lights. These were fed by a cable passing through a rubber tube, the wire being attached to a plug which fitted a receptacle which was fitted to a block of hardwood made to fit inside the different lanterns and wired for two lamps, one lamp being wired in series with a relay which, when the current was on opened the circuit connecting lamp 2, so that in case No. 1 should burn out the circuit would be broken and No. 2 be immediately closed, thus doubly insuring a constant light; these lights are governed by a switch in the pilot house.

I will also give you a few particulars of the plant on board the steamer Quebec, which is one of the largest and best equipped passenger boats in Canada, and is fitted especially for night service. The electric light plant consists of a 300 light 110 volt T. & H. dynamo, manufactured by the Royal Electric Co., Montreal. This machine turns 1200 revolutions per minute. It is belted direct to a Robb-Armstrong high speed engine turning 235 revolutions per minute. The steam is supplied by a boiler put in especially for this purpose.

The mains, which are of No. 0 wire, run direct from the machine to the ceiling and then to the busbars on the switchboard, which is made of black walnut and fitted with four single pole knife switches, mounted on slate bases; it is also arranged with a voltmeter and rheostat. The branches are taken off the busbars, which extend across the lower portion of the switch board, the branches passing upwards into a bank of cut-outs immediately above the switchboard, one side of each set passing through a switch; from the cut-outs the branches run in moulding to the different parts of the boat. The main saloon which is about two hundred and fifty feet long, is lighted by four nine light and two four light electroliers,, besides a number of side lights on brackets; there is also a light in each stateroom, of which there are about one hundred and fifty. The washrooms, lavatories, passages and promenade deck are also well lighted. The dining room is nicely arranged with lights directly over each table, and is also equipped with revolving electric fans, which have a very pleasant effect. The main deck, engine room, mess-rooms and forecastle are lighted by lamps placed in receptacles attached directly to the ceiling. The circuits and switches are arranged so that only part of the lights on the main deck and saloon can be turned off or on as desired. In all there are about 300 lights on this boat. I might say here in regard to the engine and dynamo which were put on board last spring, that we have not had the least trouble with them in any way, and that they have given perfect satisfaction.

I will also give you a few particulars of our new steamer Columbian which was built two years ago especially for this company by the Deleware River Iron Sqip Building Company, of Chester, Pa.

She is fitted up with all modern improvements. She is a twin screw steamer, being driven by two triple expansion engines of the latest type working with a steam pressure of 120 lbs. to the square inch.

The electric light plant consists of a 150 light Edison dynamo of the latest type, belted directly to a Case automatic high speed engine running at 620 rev. per minute, with 120 lbs. steam pressure. The switch-board which is made of black walnut, is fitted with two 50 amp. D. P. switches and four 25 amp. O. P. switches, also a Weston volt meter and ammeter, a ground detector and two 50 amp. branch cut-outs and rheostat. The mains run from the machine into the two 50 amp. cut-outs, one leg passing through the ammeter. From one of these cut-outs two branches are taken to supply the main deck, one running forward and one aft. From the other cut-out a set of mains is run up to the saloon deck midshipt into a tank of four cut-outs, from which run four branches, two for each side of the saloon, one running forward and the other aft. Just below each cut-out there is a switch on each branch, so that the light can be turned on or off in any part of the saloon as required. The cut-outs are nicely arranged in a neat case on the wall, with a glass door which is fastened with lock and key.

The wire used in the installation of this plant is the Grimshaw white core, and is run in a very neat moulding fastened with brass screws and very neatly put up. The saloon is nicely lighted with center electroliers and side brackets. There is a light in each stateroom, each light being controlled by a switch and protected by a small porcelain fuse block set neatly in the moulding with a mica cover and containing 1 amp. fuse link. The fixtures are of very tasteful design and are made of brass with black trimmings.

We have several other steamers lighted by electricity, but the few details I have given you I think will be sufficient to give you some idea of the construction and working of an electric light plant on board ship. I might here say that you will scarcely ever find two steamers equipped just alike as there are a great many things to be taken into consideration before installing an electric light plant on board a steam boat, such as suitable location for plant, steam pressure of main boilers; if it is necessary to put in an extra boiler; to find a suitable place to put it, &c. Then in regard to wirng and switches, some boats running only at night require to be lighted all through from dark till daylight; in others running day and nignt there are parts which require to be ligeted in the daytime as well as the night; therefore the wiring and switches must be put in, to fill, as far as possible, these requirements. There is no doubt that in the future all these and many other necessary items will be taken into consideration when new boats are built, and thus do away with the many disadvantages we have to contend with in wiring and fitting up boats after they have been completed.

Some steamers also carry search lights, but so far these are mostly used on war vessels for signalling purposes and for locating objects at a distance. On river steamers they are not considered to be of any great advantage and are looked upon more as an expensive luxury than a necessity as it is found that in order to operate a search light properly it is necessary to have a practical man for that purpose, which is quite an extra expense, as the plant is nearly always looked after by one of the engineers and does not require an extra man.

There is another system of wiring which has been used on some steamers, mostly vessels made almost entirely of iron or steel, such as war vessels. We have what is called the two wire system and the three wire system, but the system I allude to should, I think, be called the one wire system, inasmuch as only one wire is used, the iron hull of the vessel being used for the negative or return, one pole of the dynamo being grounded on the ironwork of the vessel and one wire run to each light, the opposite side being also grounded on the ironwork, but as I have had no experience with this style of wiring I would not recommend it, and you must be your own judges of the practicability of the scheme.

I might say in conclusion concerning the wonderful advances and improvements which has taken place within the last few years in all branches of the electrical business, that I believe the time is not far distant when the business will be divided up so that a man in order to be successful will have to give all his time and attention to one particular branch, and will not be expected as he now is, if he calls himself an electrician, to tackle anything from a common door bell to a street car motor or a 5000 light alternator, and I believe that steamboat lighting will be one of the important branches of the electrical business.

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* Paper read before the Montreal Electric Club.

SPARKS.

The town of Knowlton, Que., is to be lighted by electricity.

The contract for the electrical machinery required by the Cataract Construction Company, at Niagara, has lately been awarded to the Westinghouse Company, who will employ the Tesla multiphase system. There will be employed 3 generators of 5,000 h. p. each, with corresponding motors and accessories. These machines will generate 2,000 to 2,400 volts. The E. M. F. will be increased or lowered by transformers.

The Royal Electric Company of Montreal, have just completed and successfully tested a 5,000 light machine, for the Standard Electric Company of Ottawa. This is said to be the largest machine yet manufactured in Canada. The company have commenced work on the foundation of a new boiler and engine house adjoining their present station. The size of the boiler house will be 66 feet square, and of the engine house, 53 by 96 feet.

The new power house of the Ottawa Electric Street Railway is being roofed in. There have been placed in position by Messrs. Wm. Kennedy & Sons, Owen Sound, two water wheels, each 160 inches in diameter, and capable of generating 500 h. p. These wheels will be used to operate two 400 h. p. dynamos. Two additional wheels will be installed at a later date. From 900 to 1,000 h. p. will be employed in the operation of the street railway system during the winter.

At St. Anne du Sault, a few days ago, a boiler exploded in a shingle mill, causing the death of three men and injuring several others, besides causing serious damage to property. This boiler had previously been examined in the establishment of a second-hand machinery dealer, and had been pronounced unfit for steam pressure. Notwithstanding, it was sold and put into use, and after having been in use only five days, it exploded with the result stated. If machinery dealers will sell boilers of such character, it is time that the Government should insist upon proper inspection of steam boilers.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of the various Associations are requested to forward us matter for publication in this Department not later than the 20th of each month.

ANNUAL DINNER OF TORONTO NO. I.

THE seventh annual dinner of Toronto No. 1 took place at the Avondale Hotel, Toronto, on the evening of Nov. 23rd. The attendance was considerably larger than on any previous occasion. Unfortunately the accommodation provided was not adequate, so that it was found impossible to seat at once all the guests. This contingency will no doubt be provided for in the future.

Among those present were noticed the following:

Toronto—Prof. Galbraith, Principal School of Practical Science; Mr. Cassidy, Editor *Canadian Manufacturer*; Jno. Galt, C. E., M.E.; J. Inglis; A. E. Edkins, Prov. Dep. for Ontario; A. M. Wickens, Dist. Dep; Wm. Sutton, Vice-Pres. Executive; W. G. Blackgrove, Treas. Executive; W. Philip, Pres. Toronto No. 1; W. Butler, Vice-Pres. Toronto No. 1; Ed. Philip, Geo. Gilchrist, John Fox, H. E. Terry, Samuel Thompson, Geo. Fowler, Geo. Mooring, Fin. Sec'y Toronto No. 1; C. Mosley; W. L. Oathwaites; J. Barber; Wm. P. Sutton; Huggett; Ed. Appleton; Alex. Fraser, Secy-Treas. Boiler Inspection and Insurance Co.; John Perkins; Geo. Grant; A. S. Wilson; J. Sanrioll; James Wadge; F. Tushingham; Mr. Crosby, Chief Engineer T. Street Ry. Plant; S. Mathews, Asst. Eng. T. St. Ry. Plant; F. Forster; David McCulloch; Ed. Ash; R. Waterson; F. Smith, Sec'y Marine Engineer's Association; Geo. Gore; Geo. Haworth; Walter Lewis; J. Johnson; John Day; Fred. Day; George Thompson.

Hamilton No. 1.—Robert Mackie, Dist. Deputy; Duncan Robertson; J. Langdon; R. Chillman.

Kingston No. 10.—Jas. Devlin, President.

Galt—W. T. Brown.

Brantford No. 4.—Arthur Ames.

After ample justice had been done at the festive board, the toast list was proceeded with.

Mr. Wilson Phillips, President of Toronto No. 1, occupied the chair, and made some brief remarks expressive of his pleasure at seeing so large a number present. The toast of the "Queen" having been duly honored, the Chairman proposed the toast of "Canada, Our Home," and coupled therewith the names of Mr. Cassidy, of the *Canadian Manufacturer*, and Mr. Burton.

In reply Mr. Cassidy said that only a short time ago Canada was an unknown country, but to-day it was one of the foremost countries of the earth. The cause of the rapid development which had been made was chiefly the enterprise and ability of such men as were here to-night, men who were interested in the industries of the land. The Government had very wisely provided that marine engineers must be licensed, but it was not so in the case of stationary engineers. He thought it would be in the interest of all engineers if the Government would compel the licensing of engineers, in order that only competent men would be allowed to operate steam plants. It should be and no doubt was the desire of steam users to improve the standard of engineers, and they should lend a ready hand withthat end in view.

Mr. Burton was then called upon, but did not respond.

"Toronto, the Queen City of the West" brought a response from Ald. Bell who referred to the benefit derived by citizens from the formation of the C. A. S. E. They had taken a stand to benefit the public as well as themselves. In 1868 the speaker and two or three others tried to start an association but were unsuccessful. However, since the formation of the present organization great strides had been made, and its influence was being felt all over the land. He fully agreed with Mr. Cassidy's remarks regarding the licensing of engineers, and would like to see every stationary engineer a member of this association.

The toast next in order was "Our Educational Interest," which was acknowledged by Prof. Galbraith, of the School of Practical Science, and Mr. John Galt, C. E.

Prof. Galbraith congratulated the members that during the present depression there appeared so few signs of hard times among the engineers. One great cause of trouble in the present age was strikes on the part of employees. The C. A. S. E. was promoted to raise the standard of engineers, and this was the fair way to get their proportion of the profits. The trade unions should not try to force employers to put all employes on equal pay. For wage earners the true principle was for every employee to do his best, not to try to estimate his own wages, for he would be left behind in time of depression. The ambitious man is the man who endeavors to do his best for his employer; the other man has no ambition who measures his services by his pay. Engineers should educate themselves to take a broad view. With regard to educational work he could only say that they had exceeded all expectations both in the School of Science and Toronto Technical School. The speaker also referred to the advancement of electrical engineering, concluding his remarks by inviting all the members to a test of a steam plant to to be held at the School of Science on Friday evening, the 1st of December, from 7 to 11 o'clock.

Mr. Galt could remember well the formation of the C. A. S. E. It had been formed on educational lines, and education was an important and valuable feature of the association. The engineer of the past would be brushed aside if he did not keep pace with the developments in electrical and steam engineering The effects of the C. A. S. E. were being felt all over the Dominion. There was no question that a certificate of this association was a guarantee of a good honest and suceessful engineer. With regard to a Government license, he thought the stationary engineers' association was fast becoming as important or more so that the Canadian Society of Civil Engineers, of which he was a member. This society was in a similar position regarding a license law but had no fear of the future, and when the time came he thought there would be no difficulty in obtaining it. Regarding steam engines, for a time nothing was talked of but high speed engines, but there seemed to be a growing tendency at present towards the old style of slow speed engines. It was with a view to meet this demand that multipolar dynamos were being constructed. We will now have ordinary slow speed engines running dynamos and generators. Mr. Galt thought that it was only a question of time when the Canadian Association of Stationary Engineers would be recognized as the only body of mechanical engineers of importance in the land.

Mr. W. T. Brown was then called upon to respond to the toast, "Our Manufacturing Interests." In a few well chosen remarks, Mr. Brown urged upon those present the advantage to be derived from self education. The best engineers were those who studied all the details, and took an interest in themselves, their employers and their plant. He was glad to see that in small towns where there was no branch of the C. A. S. E., engineers were endeavoring to secure all the information they could, and no doubt the society would soon spread to the smaller towns also.

Mr O. P. St. John, also made a brief reply, contrasting the position of the engineer of to-day with that of the engineer in the past. At one time all that was necessary for an engine to do was to start and to stop the engine, and to keep the plant running as long as possible, but times have changed, and there now exists among engineers a friendly spirit to excel, to obtain information, and to handle their plant with economy and efficiency. Mr. St John also referred to the fact that steam users were gradually coming back to slow speed engines and he was certain there was greater economy with the long stroke engine.

Mr. Perkins, jr., also made some remarks in reply to this toast.

The "Executive Council C. A. S. E.," was responded to by Bro. A. E. Edkins, who thanked those present for the hearty manner in which the toast had been received. He regretted that their Executive President, Bro. George Hunt, was unable to be present in his official capacity, as he certainly would have received a very hearty welcome. He thought the outlook for the coming year was bright for the association. Since their meeting in Montreal an association had been started in Kingston, with a membership of 30. He found it difficult to organize new associations in small towns, which was no doubt due to a great extent to indifference, but some improvement was taking place. Papers on steam engineering had been read and published, and these papers were being read and studied by the engineers throughout the country, and as a consequence more interest was being taken in the C. A. S. E. The demand for engineers for electricity was increasing, and he urged the engineers to study along this line. When we take into consideration the large number of compound and even triple expansion engines which are now being sent out of the shops for stationary purposes, compared with a few years ago, we can more readily see the necessity for such an organization as the C. A. S. E. An organization in which men can exchange views on matters affecting their every-day duties was certainly a great benefit, and was deserving of public support, but more especially of the support of steam users. The association had nothing to be ashamed of, but a great deal to be proud of, as they were not working against employers, but to benefit them.

Mr. Edkins thought that all steam users should be honorary members of the association; they would be gladly welcome as such. It was only a matter of time when there would be a branch of the association in every town where ten or fifteen engineers were employed.

Mr. Grant was then called upon to respond to the toast of the "Amalgamated Engineers." He remarked that this society was different from the C. A. S. E., inasmuch as it was a trades organization, but nevertheless they did not rush into strikes on every occasion. They thoroughly understood the law of supply and demand. In 1851 there were a number of sectional societies in England, but being so scattered they found they had no power to improve their condition. Some of the leading men proposed amalgamation which was consummated in that year, although it met with great opposition by employers, who did their utmost to destroy it. The speaker produced some figures showing the extent to which the society had grown, and referred to the improved position of the steam engineer of to-day.

After the toast of "Old Toronto No. 1" had been drunk with enthusiasm, Mr. A. M. Wickens was asked to say a few words in reply. He referred to the formation of the association, which was commenced by eleven members, and the success which had attended their efforts, notwithstanding the opposition which had been met with. Some steam users seemed to have the idea that any person could operate a steam plant, and incompetent men were engaged who would undertake the work, the result being they got into trouble. With regard to a license law, Mr. Wickens said that after three years of persistent work, the Legislature had granted a permissive law, under which a Board of Examiners had been appointed. This Board had granted hundreds of certificates. Toronto No. 1 had spent $850 for education and legislation. The co-operation of all employers was solicited. Not long ago the speaker was called upon to examine a boiler, the botton of which had been burnt out, and he found that the man in charge had been firing away for seven hours without any water in the boiler. Some figures were then given showing the number of explosions per year and the results thereof.

There was no representative present to respond to the toast, "The Marine and Locomotive Engineers."

"Hamilton Association" was responded to by Messrs. R. Mackie and Jas. Langdon.

When Mr. Devlin rose to respond to "Kingston No. 10," he was greeted with loud applause, this association being the last one to cast in its lot with the C. A. S. E. Mr. Devlin hoped the time would soon come when an engineer would be compelled to hold a certificate in order to operate a steam plant.

After the health of the various branches of the association and of the "Press" had been drunk, the most successful annual dinner of the C. A. S. E. since organization, was brought to a close by the singing of "God Save the Queen."

The Committee who had charge of the dinner, and to whom great praise is due for its success, was composed of Messrs. Samuel Thomson, Chairman; H. E. Terry, Sec-Treasurer; A. E. Edkins, W. G. Blackgrove, J. Harper and George Fowler.

The musical part of the evening's entertainment consisted of songs by Messrs. Grant, Anderson and Blackgrove, and a banjo duett by Messrs. Tuppen and McHenry. The duties of accompanyist were performed in an admirable manner by Mr. A. E. Harding.

TORONTO NO. 1.

AT a meeting of the above Association held on the 10th November, Bro. Charles Heal presented to the association a framed photograph of the delegates to the recent convention in Montreal. The meeting was an open one, the main feature of the programme being a paper by Bro. A. M. Wickens on the "Expansion of Steam." The paper was an able and interesting one, and evoked considerable discussion, and also a vote of thanks to the author. Bro. G. C. Mooring is preparing a paper on "Combustion" to be read at the next open meeting.

OTTAWA NO. 7.

A member of the above Association under the *nom de plume* of "Corn Cracker" writes as follows:—Very seldom you get matter for publication in your columns from Ottawa No. 7. It may appear to other Associations that we are frozen stiff in this "Saw Dust" City, while others would be under impression that our officers are kept too busy attending general business. Anyway there is no reason why we should appear to be fading out of existence for the want of notice in your publication. I have no intention of going too far back in the history of our proceedings, but will say a few words regarding the last regular meeting on Nov. 14th, with the Vice-President, Bro. F. Merrill, in the chair.

One application was received and referred to the proper committee. This makes the fourth member coming in since the last convention, and one of them is a well known Toronto gentleman in the person of Bro. Donaldson, which gives proof that the good work and material in Ottawa No. 7, attracts engineers from all over the country.

Under "Good of the Order" the first question was the piston speed at different points of the stroke. The ball was set rolling by Bro. Thomas Wensley, who gave a minute explanation, accompanied with diagrams, showing the crank at different angles and the position of the piston at each of these points, demonstrating the irregularities in the travel of the piston and crank in one revolution. Several other members took part and it brought out theories, opinions and experiences sufficient to make it very interesting for all present.

The next question of importance was the capacity of pumps when some one asked why a pump would not lift hot water; this brought out once more plenty of opinions to show on what principles a pump lifts water.

As far as I can judge Ottawa No. 7 is progressing very favorably although I will admit that it has been retarded, but we expect soon to be on a level with time. Already some of the engineers have promised something interesting on engineering for the next meeting, and it is my intention to keep "the boys" posted on the ingenuity of our inventors.

KINGSTON NO. 10.

Editor ELECTRICAL NEWS AND STEAM ENGINEERIMG JOURNAL:

I was in Kingston from Oct. 21st to 24th inclusive, and, having a few hours time to spare, took advantage of it to visit the steam plants and engineers and in conversation with some of them, regarding the C.A.S.E., I suggested the advisability of the Kingston Engineers' Association being made a branch of the C.A.S.E. The result was, that after due consideration, an advertisement was inserted in the two papers calling on all engineers to meet at 7.30 p.m. at No. 1 Fire Hall (on Tuesday, Oct. 24th) to consider the advisability of organizing a branch of the C.A.S.E. in Kingston. I was informed that the Kingston Engineers' Association was composed of thirteen members, and to my surprise and delight, when I arrived at the place of meeting on Tuesday night I found between 25 and 30 engineers in the hall. The president, Mr. J. Campbell, being absent, the secretary appointed Mr. J. Devlin, Chief Engineer of the K. Penetentiary, to take the chair, which he did, and after calling the meeting to order, requested that I should address the meeting on the principles, aims, and objects of the C.A.S.E. and the benefits to be derived from membership.

After some discussion it was resolved, That the Kingston Association of Stationary Engineers be abandoned and that a branch of the C.A.S.E. be formed, and application for a Charter accompanied by the usual fee be handed to Bro. Edkins at once. After some 25 engineers had given in their names for membership, the election of officers was proceeded with, which resulted as follows:—President, James Devlin, Chief Engineer K. Penetentiary; Vice-President, H. Qaulden, Chief Engineer Fire Department; Treasurer, H. Hopkins; Recording and Financial Secretary, Anthony Strong, Chief Engineer Dominion Cotton Mill (residence, corner of Bagott and Charles St.); Conductor, J. Langhrane; Door Keeper, J. Gascoigne.

After the initiatory ceremonies were concluded, it was resolved, That a vote of thanks be tendered to Prov. Deputy Bro. A. E. Edkins, for the interest he had taken and work he had performed in the organization of Association No. 10. It was also resolved, That the thanks of this Association be tendered to Bro. H. Gilmour for his services as secretary of the late Kingston Association of which he was a most devoted member.

This brought Bro. Gilmour to his feet, and in the course of a neat speech, he said that as they were now attached to the C.A.S.E. he was determined to do everything in his power to further the interests of the Association and he trusted that every member would make up his mind to attend regularly and not only learn all he could from others, but be ready to give his experience for the benefit of his Bro. Engineers. From what he knew of the C.A.S.E. and its principles he felt that it was working in the right direction both in the steam user's interest and in the interest of engineers, and from the enthusiasm which had been shown by the members, he predicted a fine healthy and in every sense of the word useful branch in Kingston.

President, Bro. Jas. Devlin, then addressed the meeting asking the officers and members to give him their support in carrying out the work of the Association.

It was decided that the Association should meet every 2nd and 4th Tuesday at 8 p.m. in Engineers' Hall, over No. 1 Fire Hall.

Regret was expressed by several members that Bro. R. King could not be pursuaded to take office, as he is known as a worker and an energetic engineer. Bro. King is Chief Engineer for the Kingston Light, Heat and Power Co, and told the Association that his duties in that capacity would often necessitate his absence from the meetings, and for that reason he could not take office.

Meeting adjourned at 10.30, when light refreshments were served and a pleasant half hour spent in general conversation.

These "Limestone City" Engineers are alive and are determined to make No. 10 outshine everything.

Yours, etc.,
A. E. EDKINS,
Prov. Deputy.

[The above was received too late for insertion in our November issue.—Editor NEWS.]

TRADE NOTES.

The Peterboro' Electric Railway Co. has placed an order with Ahearn & Soper, Ottawa, for one vestibule car and one rotary snow-sweeper, both equipped with Westinghouse motors.

The old-established business of Messrs. F. E. Dixon & Co., leather belting manufacturers, of Toronto, has recently been converted into a joint stock company. Mr. F. E. Dixon will continue in the management of the business.

We call attention to the first appearance in this issue of the advertisement of the Steam Boiler and Plate Glass Insurance Company, of London, Ont. The company will assist in educating the owners of steam boilers to the necessity for regular and competent inspection of steam plants.

Messrs. Wm. Kennedy & Sons, manufacturers of water wheels, etc., of Owen Sound, have recently added to their works a gear dressing machine capable of dressing the iron or wooden teeth of spur or bevel gears up to $20\frac{1}{2}$ inches face. The machine works automatically, and will dress teeth of any shape. There are said to be only four machines of this kind on the continent.

The Reliance Electric Mfg. Co., of Waterford, have made the following sales: Prescott Electric Light Co., 900 light alternating current incandescent plant; The Ontario Government, for Central Prison, Toronto, 35 light dynamo, 35 arc lamps, 200 light direct current incandescent plant; The Parkhill Electric Light Co., 30 light arc dynamo; The New Hamburg Electric Light Co., 15 light arc dynamo; The Canadian Oiled Clothing Co., Port Hope, 50 light incandescent plant; Wiarton Electric Light Co.. 60 light arc dynamo; Watford Electric Light Co., 40 light arc dynamo; The Sutton Electric Light Co., Simcoe, Ont., 750 light alternating current incandescent plant; The Slingsby Mfg. Co., Brantford, Ont., 200 light direct current incandescent plant. In addition to the above the Company have recently sold a large number of stationary motors.

The Ottawa Street Railway Company propose to double track their Rockliffe, Elgin and Catherine streets' lines.

The Nanaimo, B. C., Telephone Company has just paid a dividend of 10 per cent. The retiring directors, Messrs. W. F. Salsbury, Pimberry Norris, and Praeger were all re-elected.

ELECTRIC RAILWAY DEPARTMENT.

THE TORONTO RAILWAY COMPANY.

The following particulars of the power plant and equipment of the Toronto Street Railway is abstracted from a recent number of the *Street Railway Journal* from which also the accompanying illustrations are reproduced.

The power station (Fig 1) is 137 x 122 ft., and was originally a stable, as may be inferred from the many windows. It is located at the junction of Frederick and Front Streets, and is of red brick and stone trimmings. Geo. F. Hammond, of Cleveland, was the architect, and the iron work was provided by the Dominion Bridge Company.

The boiler room has a trussed roof, leaving it free from posts or pillars of any kind. The roof, which is fifty-two feet from the floor, has in it two large ventilators, giving plenty of fresh air. Doors, which are raised with weights, are situated along the front of the building, permitting the removal of ashes and cinders with the least possible amount of handling. The steam equipment consists of twelve 72 in. × 18 ft. boilers, made by the Polson Iron Works, of Toronto, and containing seventy-two four inch tubes each. The smoke breeching for the boilers is of one-quarter inch plate steel, and is connected to each boiler and to the stack at its center. Each boiler has a seven inch steam branch to the fifteen inch steam header, the latter being made of fifteen inch, lap welded tubing, with steel flanges at the ends and steel nozzles along the shell, these all being riveted and caulked. Feed water is taken from the hot well at the condensers to each of the three feed pumps, and from there to either of the two Morse heaters, and from the heaters to either of the two feed mains. One feed, which is operated by hand, delivers into the bottom of the boiler through the blow off. The upper feed discharges, through Hartford style of piping, in the upper portion of the boiler, and is controlled by an automatic feed regulator. The pumps are five in number, three being of the Davidson type, and two automatic, and are also controlled by a pressure regulator. The feed water is heated by steam that passes through the pumps, the pumps being run with sufficient back pressure to supply the heater with the required steam. In case the steam from the pumps is not sufficient for the heaters, regulating valves will admit of enough more to bring up the pressure. The pumps are so arranged that they can exhaust into the atmosphere, if desired, the steam for the heaters, in that case, coming directly from the steam main. The steam header pump suctions and dischargers are all so arranged as to divide the station into two distinct halves, permitting either half to be run independently of the other. At each header there is an automatic pump which delivers all the condensation from the heaters and header back to the boilers. Schaffer & Budenburg gauges are used.

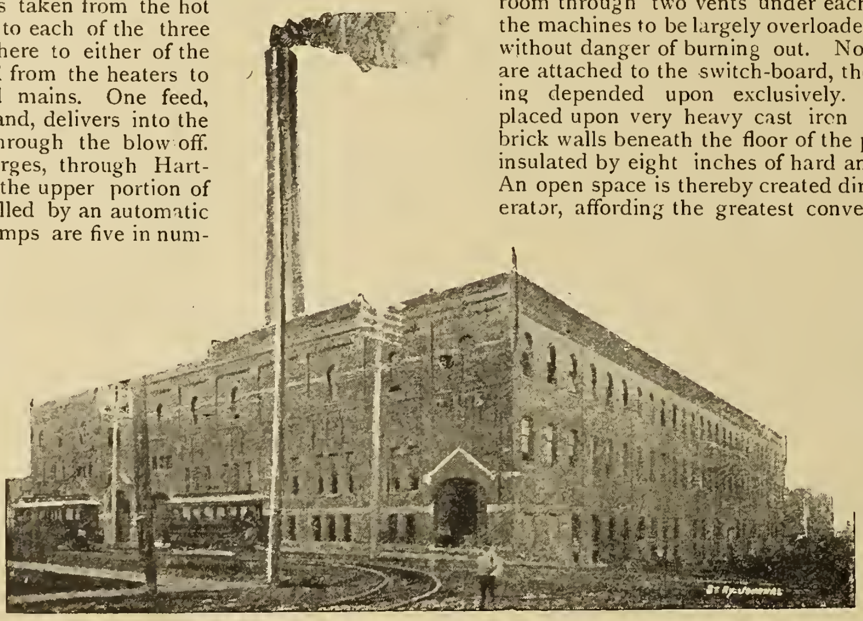
Fig. 1—Power House, Toronto Railway Company.

The engine room has a trussed roof, with ceiling fourty-four feet high. The flooring is of 6 inch hemlock scantling laid on edge on steel joists, and this is covered with one and a quarter inch hard wood flooring. The room presents a handsome appearance, as the engines and belts are protected with iron railings fitted with polished brass trimmings, and the building is lighted with incandescent and arc lamps run from the railway circuit. A large traveling crane, with a capacity of twenty tons, stretches entirely across the room.

The power equipment consists of five Armington & Sims 600 h. p. engines. Four of these were specially manufactured for this plant, and have each two driving wheels, 25 ins. × 9 ft., placed between the high and the low pressure cylinders, each half engine being on a separate base, with a crossover steam pipe below the floor. All the engines have Corliss valves for the low pressure cylinder, with a new design of valve motion, so arranged as to give a quick cut off, and make a card similar to a Corliss. Each engine is connected to independent Davidson condensers; there are also branches to the automatic relief valves, and thence through the roof. The engines are so piped that they can be run non-condensing, and while in this condition with the load on, can be connected with the condensers without stopping or throwing off any load. Should the condensers drop their vacuum the relief valves will open instantly and permit the engines to run non-condensing till the vacuum is restored. The condensers take water through a 30 inch steel pipe from the lake, a distance of 620 feet., being under the water line for the entire distance. Each condenser discharges through a ten inch pipe into a discharge main which empties into a 30 inch brick sewer. The condensers are placed below the floor in front of the engines, and are easily accessible by a flight of stairs.

These engines are connected directly with ten 200 k. w. Edison standard generators. All cabling and wiring is taken down through the floor, and carried separately to the station board. The latter is 27 feet in length, and has an ornamental front. The frame is of wrought-iron, and the facing of enamelled slate slabs finished in polished cherry. The amperemeters are of the Edison type, and the volt-meters and circuit breakers of the Westinghouse type. Each feeder has an ampere circuit breaker, and a two-way switch used for high and low pressure in cases of emergency. Below the switch-board in the basement, is a Wurts tank lightning arrester. Each of the eleven feeders at the point of entrance to the building is also protected with a Wason four-fuse lightning arrester.

The belts employed were all made from hemlock tanned leather, and were supplied by the Howarth Belting Company of Toronto.

The generators are protected from overheating by a forced draft of air taken from outside the building and transmitted in pipes under the floor by electric power, and entering the engine room through two vents under each armature, enabling the machines to be largely overloaded in cases of necessity without danger of burning out. No fuse wires whatever are attached to the switch-board, the circuit breakers being depended upon exclusively. The generators are placed upon very heavy cast iron arches supported on brick walls beneath the floor of the power house, and are insulated by eight inches of hard and soft wood flooring. An open space is thereby created directly under each generator, affording the greatest convenience for inspection.

The basement is fitted with wash rooms, sleeping apartments, store room, etc.

The company's new motor house, which is of red brick and stone, is nearly complete, and measures 140 × 105 ft. It is situated on the northeast corner of Frederick and Esplanade Streets, and extends back to the power house lot. There are large entrances at either end, permitting cars to loop round. Six tracks run through and are fitted with the necessary pits, etc., their entire length. Two of these are used exclusively for the inspection of cars, while the other four pits are fitted with hydraulic lifts, etc.. necessary for motor equipments and repairs. One side of the building is arranged for the receiving and storage of equipments and spare parts.

All the buildings are fitted up with incandescent lamps run in series of five from the railway circuit.

The company has four large car barns. One is situated on King Street East, near the River Don, and is of red brick and stone. This building is 194 × 164 ft. and will hold 136 cars on the ground floor. It was used as a stable before the adoption of of the electric system and has recently been remodeled to adapt it for the purposes for which it is now used. Another new, handsome car barn, built last season, is situated on Yorkville Avenue and extends through to Scollard Street. This is of brick and stone, and is 242 ft. long by 100 ft. in width. Three large entrances are at either end, with tracks extending entirely through the building, permitting the cars to loop round. The entrances are far enough apart to allow of turnouts at either side of the main tracks, thus making nine tracks the entire length of the barn. The main tracks running through are fitted with the necessary pits for inspection of cars. All cars from the Bloor, Yonge and belt line routes are stored in this barn.

Two other barns are located on the junction of Front and Frederick streets, one being on the northwest and the other on the south east corner. The latter is shown in Fig. 1, at the left of the power house. Both of these buildings are of brick and stone, and are three stories in height. The Queen, Brocton, Dovercourt, Church, Bathurst, Winchester and Parliament line of cars are stored here.

The building on the southeast corner measures 137 × 60 ft. The first floor is used as a machine shop, and contains lathes, saws, drills, hammers, presses, etc., necessary in the building and repair of cars. Another portion of this floor serves as a temporary motor shop pending the completion of the company's new motor house, described above. The second floor is used as an armature room, where the company does all its own repairs, such as rewinding of armatures and fields. Several new motors of the company's own make, which have given excellent satisfaction, have been turned out here.

The car house on the northwest corner is 140 × 80 ft. On the first floor are located the car building shops, while the second floor is used by the extensive paint department of the company.

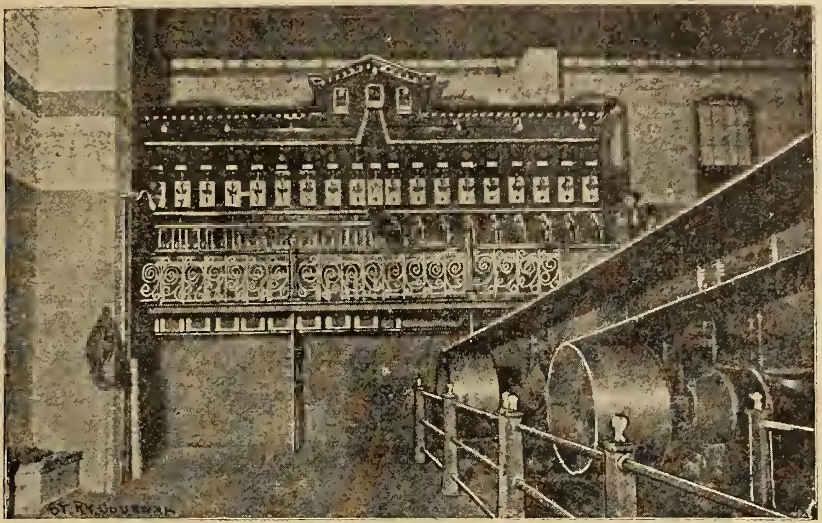

FIG. 2—SWITCHBOARD IN POWER HOUSE, TORONTO RAILWAY COMPANY.

All the car barns are fitted up with wash rooms, waiting rooms, offices, elevators, and all conveniences for the employes.

The company also owns a large, three story, brick and stone building at the corner of George and Front streets, known as the George street stables. All the horses, numbering about 650, now in use on the system, are concentrated at this point. On the second floor of this building is the stores department with all the necessary receiving rooms, etc., for the storage of supplies. On the ground floor is the harness room where all the harness used is made and repaired.

The new track is laid with seventy-three pound grooved girder rails, laid directly on cedar ties. The switches are of steel, and, with the crossings, curves and special track, were provided by the Canada Switch Company, of Montreal. The bonds are thirty-six inches long, of No. 0 copper wire, connected to rails by seven-sixteenths of an inch special rivets. Cross connections are made every 250 ft. with No. 1 wire, and the rails are also connected at intervals with the water mains by means of No. 1 insulated wires. The maximum grade is 5 per cent. extending for a distance of 80 feet, and all curves are of forty-five and fifty feet radius, the maximum allowed by the city engineer. The rails were supplied by Dick, Kerr & Co., of London, England.

The company owns 95 motor cars, 193 box cars and 83 open cars. All the cars of the company were manufactured at its own shops at the corner of Front and Frederick Streets. They are unlike any other make, and were built from designs supplied by the company's shop foreman, Mr. Powers. They are all of a standard size of eighteen feet in length, with extended platforms, making the car twenty-eight feet over all by seven feet ten inches in width. They are quite high and light inside, and have six large windows on either side, with a corresponding number of ventilators in the roof. All the cars have, front and back, large, plain lights which have painted in black upon them the name of the route. These lights are easily removable and can be replaced by others when the car is changed from one route to another. The doors are of quartered white oak, with drop sash and cherry panels. The inside of the cars is finished in quartered oak and cherry panels, and has two large, bevel, English plate mirrors, one at either end. One standard color is in use, the top panels being Harrison's new Tuscan red, while the bottom panels are of Broadway cadmium. The inside of all the cars is finished in oil, with a very little, delicate, ornamental beading along the borders. The seats are beautifully upholstered in Wilton, with the company's monogram woven in the backs. Coil springs of the latest improved type are used. The cars are lighted with a series of five incandescent lamps. The horse cars are lighted with an oil lamp at either end.

Thirty-seven motors were supplied by the Westinghouse Electric & Manufacturing Company, and are of the thirty horse power, single reduction type. All the others are of the Edison type, with the exception of five Thomson-Houston and three Spragge motors. Six McGuire, one Brill and one Taylor trucks are used. The remainder were built by the company, and are of wood. The truck springs are elliptic in the case of the motor cars, and straight in that of the trail cars, and Jones and Bemis gears are used. Electric heaters have been adopted for the motor cars, and Royal stoves for the trail cars. Some of the heaters were manufactured by the company, others are of the Dewey type. Lappin brake shoes and the old type of "coffee pot" fare receivers are employed, though the latter are to be retired for later appliances.

The company owns one electric and ten Walkaway snow plows.

The longest line in the city is the King street line, which is over seventeen and a half miles for the round trip. This line connects the extreme west and east ends of the city, and is very popular during the summer months in conveying people from High Park to Victoria Park, one at either end of the route.

The number of passengers per car mile run during the last fiscal year was 3.9. The average watts per car, when only motor cars are used, is 10,640; when motor and trailers are used, per car, 7,980.

The authorized capital stock is $6,000,006.

RECENT PATENTS.

CANADIAN.

43,759.—Hugh Webster Williams, Victoria, B. C., explosive engine.

43,824.—George H. Waring, St. John, N. B., steam engine.

43,895.—The Bell Telephone Company of Canada, Boston, Mass., telephone.

AMERICAN.

John D. McEachren, Galt, Ont., steam boiler cleaner, No. 507,030.

Herman H. Brown, Montreal, Que., insulated wire, No. 507,257.

Cyrus S. Dean, Fort Erie, Ont., boiler flue cleaner, No. 507,421.

PUBLICATIONS.

"Standard Tables for Electric Wiremen, with instructions for Wiremen and Linemen, Uuderwriters' Rules and useful Formulae and Data, by Chas. M. Davis, fourth edition. thoroughly revised and edited by W. D. Weaver, flexible morocco, 128 pages, price $1.00. The new edition of this work contains the latest revisions of the Insurance Rules of the Underwriters' International Electric Association, now almost exclusively used in the United States In addition to the above rules there has been added to this edition an important section on the calculation of alternating current wiring, which for the first time brings this subject within the reach of practical men. The W. F. Johnston Co., New York, are the publishers.

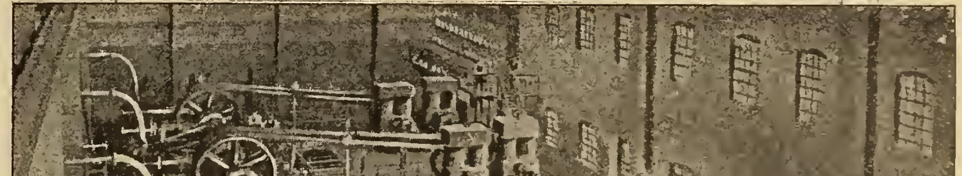

FIG. 3.—INTERIOR OF ENGINE ROOM, TORONTO RAILWAY COMPANY.

The November *Arena* closes the eighth volume of this popular Review, which, by the conspicuous ability of its contributors, its unequalled, fearless, and healthy reformution impulses, has become a power in the land.

ELECTRIC MOTORS.*

SOME men are born great, some acquire greatness, and some have greatness thrust upon them. As one of the latter I must be counted, and if my remarks are not as interesting as I could wish them to be, please remember that the honor you have conferred upon me was as unsolicited as it was undeserved by me.

The subject I have chosen, "Electric Motors," may appear about as appropriate to deliver before a society of engineers as if I were to go to the Club Canadienne and attempt to advocate certain peculiar advantages which the German language has over the French; but I know I am talking to a body of intelligent, thinking men, whose principal tools must necessarily be "brains," and I do not fear a verdict such as was given in Scotland years ago when a lecturer, who ventured to remark that hand-looms would be superseded by machinery, was told by the operatives that "the sooner his friends looked after him the better"; but, just as the words of the man who was then looked upon as insane have come literally true, there are significant signs that the mighty monarch "Steam," who has so long held absolute sway, must sooner or later give place in many instances to its rival "Electricity."

Numerous hydraulic, compressed air and similar devices have been in the market for supplying power, but, I think it is safe to say, have not come anywhere as near to supplying the general demand for small powers as the electric motor, which is steadily gaining ground and is apparently "come to stay."

Do not for a moment imagine that I claim the extinction of the steam engine; but what I do claim is that fewer will be used, and those which remain will be larger units. Waterfalls are being harnessed rapidly and converted into electric power to be conveyed in an easy manner considerable distances; windmills in conjunction with accumulators have been advocated, and in a small way have had fair success, but what is earnestly sought for and is being experimented on by many is the production of electricity from heat direct. This, as can readily be seen, would cause quite a revolution in electric power production.

The economical limit of the electric motor must be judged primarily on cost of power, and secondarily, by circumstances, such as space, fire insurance risk, capital, etc., so no fixed rule will apply, as both factors vary in different places.

Let us see the advantage to be gained by the electric motor:—We save space, attendance, coal, water, heat, etc., the latter an important item in a Canadian summer. The cost of the electric power, of course, balances some of these items. You may say that you are at the mercy of a wire, which may be broken or cut through many causes. This is very true, especially with the primitive overhead construction system at present in vogue by many companies: but will be lessened to a great extent where underground systems are used, as for instance, in New York, Toronto, etc.; and even admitting the risk, it is no greater than being at the mercy of your own engine, boiler, or engineer. Repairs, in any case, should be more promptly done to the electric motor, as it is easier knocked down for handling.

Central stations supplying the power have generally reserve engines and generators on hand, which can be switched on in an instant when any breakdown occurs.

One of the faults, if not *the* greatest, lies with the customer in wanting to purchase too small a motor to perform the work; and, in the majority of cases, the very cheapest motor on the market is what is most in demand.

Electricity is not alone in this; steam engine manufacturers have unfortunately to combat this serious difficulty also; but what is in favor of the steam plant is that generally it is rated low, and an engine of a rated horse-power will do a certain per cent. more than that work if called upon to do so. In any case, if I understand steam principles aright, an excessive overload will simply stall the engine. Not so with the electric motor, however; the so-called "safety" cut out with its fusible plug has shown itself time and again to be unreliable, and burnt out armatures are of common occurrence. A better protection would be an "electro magnetic" cut-out, which would open the line as soon as more current attempted to pass than it was set for, but these are not yet in common use.

A few words as to the measurement of electric power may be of use to members of the society who wish to test a motor at any time.

"Voltage" is the term used to denote electrical pressure, and is synonymous with "pounds per square inch" as used by engineers.

"Amperes" is a term to denote the quantity of electricity, and may be likened to "cubic feet of steam."

A "Voltmeter" for measuring the pressure of the current is bridged across (or placed "in shunt" as it is termed) the feed wires which run to the motor.

One of the wires is cut and an "Ampere Meter" let in—placed in "series" as it is termed.

The motor is now started up and the readings of both meters are taken.

When volts are multiplied by amperes the product is termed "Watts," 746 of said watts being the electrical equivalent of 1 horse power.

Now we will suppose our voltmeter shows 250 volts and the ampere meter 3 amperes, the product we see is 750 watts, or just about 1 horse power, which our motor is developing. This is not absolutely correct, as the efficiency of the motor itself is not taken into account, but is the way that such tests are usually made.

A few words may not be out of place explaining why an electric motor runs at all. A magnet, as you know, has two poles, north and south: now, if the opposite poles of two magnets are brought together, they will attract each other, but if similar poles are brought together a repelling action takes place. Steel holds this magnetic effect; soft iron, however, is only magnetic when surrounded with convolutions of wire bearing an electric current. These latter magnets are called "electro magnets" and are the principal factors in both motors and dynamos.

Now as we know electricity has two poles also, it follows thus that we may make the poles of our electro-magnet either north or south at will, according to which direction we allow the current to flow through the wire. This changing of direction of the current is accomplished by the devices known as commutator and brushes. We thus see that it is simply a matter of attraction and repulsion of two magnets, one termed the "field," which is as a rule stationary, and the other termed "armature," which revolves.

The uses of the motors are many, and probably most of them well known to the members here, so we will only touch on such uses as may be novel and interesting.

The Crocker Wheeler Co. has made direct applications of their motors, without the aid of any shafting or belting, to operating the Gatling gun, cloth-cutting machines for clothing factories, engine lathes with motor concealed in head-stock, screwing machines, pipe cutters, punch presses, etc. The Crocker Wheeler Co. claim higher efficiency in factories by this method, as belting and shafting are done away with and each machine is under individual control.

A thirty-ton locomotive for handling freight at the rate of thirty miles per hour was turned out at Schenectady, N. Y., lately, and showed up well in the test, being coupled back to back with its steam competitor.

I had intended going a little into accumulator work to show how reserve power might be had at will for stationary motors, not, mark me for street railway work, in which case I can cite many reasons why the accumulator car would not be a success either financially or otherwise here; but this would take some time, I fear, and I have occupied too much already, so will therefore make way for those who are to follow with other papers on subjects more in your line and more ably handled. If, however, my rambling remarks have awakened an interest in a subject which has such fascination for me, I shall feel repaid for any little time spent on what has been a labor of pleasure.

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*Paper read by W. B. Shaw before the Canadian Association Stationary Engineers.

ENGINES FOR ELECTRIC WORK.

GALT, ONT., Nov. 15, 1893.

Editor CANADIAN ELECTRICAL NEWS.

DEAR SIR,—I have read with considerable interest an article on the style of engine best suited for electric power stations, in the July number of the ELECTRICAL NEWS, also a letter in the November number from a correspondent in reply to the article mentioned. Before saying anything concerning the letter I might just state that my experience has been such as to lead me to the same conclusions as the writer of the above named article, for every conclusion arrived at by him is correct so far as I am able to judge; at the same time it must be admitted that the letter in reply is an able production from the writer's side of the question, but are all the conclusions at which he arrives correct in every point? I think not. It is true that the high speed engine has more opportunities to correct the difference of speed caused by variation of load, and it needs them all on account of the lightness of its parts. The writer of the reply will find if he makes proper inquiries that there are slow speed engines which have very sensitive governor attachments, regulating very closely, in spite of what he may say to the contrary. He is of the opinion that the difference in economy between the two styles of engines has never been accurately determined, but admits that under favourable conditions the long stroke slow speed engine will develop a horse power with less steam than the short stroke high speed working under the same conditions. By taking a trip through the principal cities of the United States, he will find that in a great many cases the high speed engines have been removed to make room for the low speed ones; it is not uncommon to find electric light and power stations where they removed two and even three high speed engines to put in one slow speed, and by doing so have saved nearly one-half of their boiler capacity; there is, therefore, but one conclusion to come to as to why they made the change—it was that they would have better economy and fewer repairs. If an engineer will consider the question with an unbiassed mind, he will soon realize that it is impossible for a high speed engine to give as good economical results as the slow speed. It is a well established fact that the clearance is the cause of considerable loss and might be termed a necessary evil even when reduced to all that it possibly can be, consistent with a proper and sufficient port area. We shall suppose the clearance space as small as possible in an engine 16″ dia. x 48″ stroke, and the space the same in an engine 16″ dia. x 16″ stroke; while this space might in the 48″ stroke only be equal to 3 or 4 per cent.—say 4 per cent.—in the 16″ stroke it would amount to 12 per cent. Then in most of the high speed engines this loss is still increased from the fact of using a single valve, which necessitates ports with larger area, and besides, in nearly every case it is necessary to have an excessive amount of compression to insure a quiet running engine. For the foregoing reasons, the high speed engine has never given as good economical results as the slow speed, and it is safe to say that it is impossible for it to do so in the future.

When using the term high speed and low speed in connection with the engine, it is not meant that there is any difference in speed of piston—this may be the same in both make of engines—but in order that the short stroke engine make the same piston speed, it is necessary that the speed of the reciprocating parts be greatly increased over what is necessary in the case of the longer stroke engine.

Regarding the repairs on the high speed engine, the fast motion of the reciprocating parts must of necessity cause much more wear than there is on the same parts of the slow speed, and for this reason the shutting down for repairs would be more frequent with the one than the other. It might be well to quote from a paper lately written by Chas. T. Porter, the father of the high speed engine, in which he says: "I would ask builders in their own interests to resist the temptation to get the utmost out of a given engine and set their faces like flint against the demand for short stroked engines which will occupy but little room." As this is quoted from a paper read by Mr. Porter at the Engineers' Convention lately held at Chicago, it must of necessity be considered a matured opinion of one of the ablest consulting engineers of the present day; as it was given after a great many years of experience, besides being himself a builder of engines, he must have had good and sufficient reasons for placing the foregoing remark on record. These are points which are so well understood by the majority of engineers that it is not necessary on this occasion to occupy any more space.

W. T. BROWN.

A by-law has received its first reading in the London City Council to raise $65,000 for the purchase of an electric light plant. The proposal of the Street Car Company to introduce electric power will also be considered at the next meeting of Council.

. . . THE . . .

Canadian General Electric Company

LIMITED.

HEAD OFFICE:

65 to 71 Front Street West.

TORONTO, ONT.

CAPITAL,

$1,500,000.

FACTORIES:

Peterborough, Ont.

Branch Offices and Warerooms:

124 Hollis Street, HALIFAX, - N. S.
1802 Notre Dame St., MONTREAL, - QUE.
350 Main Street, WINNIPEG, - MAN.
Granville Street, VANCOUVER, - B. C.

Thomson-Houston Street Railway Generators and Motors

(Same as built by us for Niagara Falls Park & River Railway.)

Thomson-Houston Systems of Alternating Current Apparatus for Incandescent Lighting.

Edison-Systems of Low-Tension Direct Current Apparatus for Incandescent Lighting.

Electric Arc Lighting Apparatus. Electric Mining Apparatus.

Apparatus for Long Distance Transmission of Power.

WE MANUFACTURE IN CANADA EVERY DESCRIPTION OF ELECTRICAL MACHINERY AND ELECTRICAL SUPPLIES.

INSULATED WIRES

FOR ELECTRICAL USES

Our wire factory is one of the best equipped on the continent.

We manufacture every description of insulated wires and cables, and our large production enables us to offer special values.

We desire at this season to call attention to our

Standard Weatherproof Wires,
White Weatherproof Wires,
Rubber Covered Wires,
Magnet Wires,
Office and Annunciator Wires,
Flexible Incandescent Light Cords.

Our solid core Rubber Covered Wire has the best insulation resistance, best quality of rubber, and gives the most general satisfaction to users.

TRANSFORMERS

To no other class of apparatus can the axiom that "the best is the cheapest" be more truly applied than to electrical machinery and appliances. To transformers does this especially apply. It will pay you to buy the best in the market, and we now offer you the very best at such a reduced price that the essentials of quality and efficiency are combined with extremely low prices, which is rendered possible only by the introduction of improved labor-saving machinery, added to a large increase in our output.

The Transformer we offer is the improved type F. Thomson-Houston design, celebrated for its high efficiency and perfect regulation.

The following points in a Transformer are all essential: (1) Perfect safety; (2) high efficiency; (3) good regulation; (4) small core loss; (5) convenience in installation.

These are attained in the New Type F. Oil Insulated Transformers (which we are now manufacturing at our works at Peterborough, Ont.), in a greater degree than any other upon the market.

Write to nearest office for prices and discounts.

INCANDESCENT LAMPS

We have, during the past two months made such changes and improvements in our methods of manufacture, and in the general appearance of our lamps, that we offer you, with confidence, a lamp that we are assured is now superior to any other in the market.

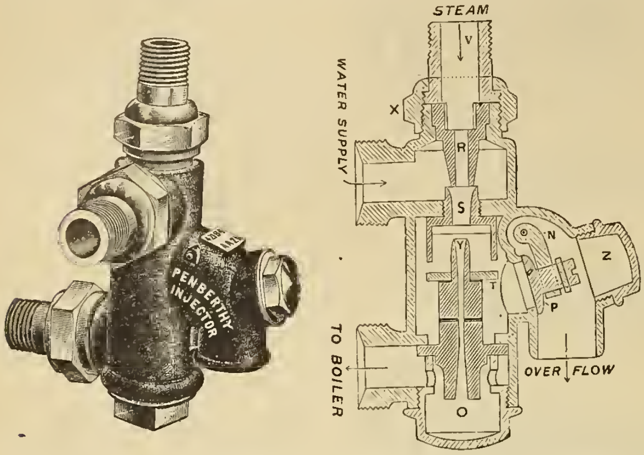
We have adopted an entirely new method of treating and handling our carbons, and have so improved our methods of inspecting and testing throughout each department and process that all inherent defects are eliminated before the lamps are passed for shipment.

Price list and discounts furnished on application.

OUR LAMP SOCKETS ARE THE BEST AND CHEAPEST IN THE MARKET.

THE PENBERTHY INJECTOR.

We illustrate herewith one of the most popular boiler-feeders that has ever been introduced to the steam using public. The Penberthy automatic injector was first placed on the market in the spring of 1887. At that time there were no thoroughly successful automatic injectors manufactured, almost the only boiler feeder in use, aside from the steam pump, being injectors of what is known as the positive class, which require constant attention and considerable manipulation of valves in order too restart them if the current of water to the boiler is broken for any reason. This injector, therefore, had great opposition to encounter and great incredulity to overcome before it could make for itself a successful place with the trade. From that time to the present it has been the constant aim of the manufacturers of this injector to make such improvements and changes as should increase its working qualities. In this they have succeeded admirably, having to-day a machine which is recognized throughout the country as the standard among automatic injectors.



It works at from 20 to 25 pounds low steam, according to size of the injector, and from this point up to 145 or 150 lbs., its best working point being, of course, about midway of its range, or at 65 to 80 lbs. On these pressures it will lift water from 22 to 24 feet, and it is claimed to be the only injector manufactured which will work equally well through hot or cold suction pipe. This is a very great advantage, as frequently the steam valve will not close perfectly tight, and when an injector is shut off, the steam leaking through the valve will heat the body of the injector and also the suction pipe, so that with other machines except the "Penberthy" it is necessary to cool this pipe before the water can be lifted.

During the six and a half years that this injector has been in the market, nearly 75,000 of them have been sold and almost without exception they have given satisfaction from the start. The manufacturers write us that while they received calls at their exhibit in Machinery Hall at the World's Columbian Exposition from nearly all their extensive trade throughout the United States and Canada and from many thousands of engineers who have used and are using their goods, they only received two complaints from any cause whatever, and these were of such a nature that a few words of explanation and instruction set the matter right with the parties who made them. An examination of the sectional cut will show the simplicity of this injector, the inside parts being very easy to get at for purpose of cleaning or examination. The steam jet "R" can be removed by simply loosening the nut on the top of the injector, while the delivery jet "Y" which is the one most liable to stoppage by dirt, can be taken out without disturbing the connections to the boiler, by simply unscrewing the plug "O" in which this jet rests.

This popular injector is manufactured by the Penberthy Injector Co., of Detroit, Mich., who will be pleased to send their catalogue to any steam user who desires it, on application. They issue monthly an 8 page paper, called the "Penberthy Bulletin," which they will send to any engineer who will send them his address.

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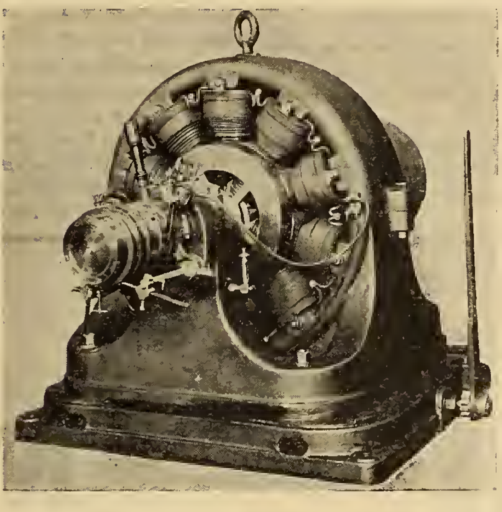

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SPARKS.

The construction of an electric railway at Edmonton, N. W. T., is under consideration.

The formation of associations of stationary engineers at Sherbrooke and Three Rivers, Quebec, is in contemplation.

The capital stock of the Citizens' Light and Power Company, of Ottawa, has been increased from $100,000 to $200,000.

The proposed electric railway to connect the City of Brantford with Selkirk on Lake Erie, is estimated to cost $200,000.

A 125 h. p. Robb-Armstrong engine has been ordered for the Intercolonial Railway's electric light station, at Moncton, N. B.

A new 1,000 light dynamo and also a new engine have lately been purchased by the St. Johns, Que., Electric Light Company.

Mr. Edison, father of the celebrated inventor, is still living. He is said to have been born in Nova Scotia, on the 7th of August, 1803.

A long distance telephone line, connecting Fredericton, St. John, Halifax and intermediate points, is being constructed by the Moncton, N. B., Telephone Company.

The contracts for ties, trolley poles, fencing and the erection of a power house for the Hamilton, Grimsby and Beamsville Electric Railway Company will shortly be awarded.

The town of Waterloo, Que., is to be lighted by electricity. There will be employed for this purpose forty 32 c. p. incandescent lamps; the cost will be $400 per year.

An offer is said to have been made to the town of Richmond, Quebec, by the Richmond County Electric Company, to light the town for 99 years for the sum of $11,000 cash.

The fly wheels for the engines in connection with the Montreal Street Railway Company's new power station each weigh 40 tons, are 28 feet in diameter, and will run at a speed of 68 revolutions per minute.

The Montreal Board of Trade are installing an incandescent lighting plant. Two engines of 80 h. p. each, of the Robb-Armstrong Company's manufacture, will furnish the power for 1,200 incandescent lights.

The Thousand Island Railway Company, of Gananoque, are considering a proposition submitted by the Kingston Electric Light Company, for the conversion of the road, which is now operated by steam, to the trolley system.

The new power station of the Selkirk Electric Light Company is about to go into operation. It is said that the company will have sufficient surplus power to be able to furnish part of the power necessary for the electric railway between Selkirk and Winnipeg.

Mr. Bremner, one of the electrical engineers of the Montreal street railway, has invented an electric brake which it is reported has been successfully tested. A car furnished with one of these brakes was brought to a stop within the space of four car lengths, while running at a speed of 20 miles an hour.

An electric railway is projected to run from Cote des Neiges across the summit of the mountain at Montreal. Mr. David Yuile is the promotor of the enterprise, for which a charter has been obtained. The length of the road will be about 2½ miles, and it is expected to be in operation by the first of the new year.

The City Council of Halifax have accepted the tender of the Halifax Illuminating and Motor Company for street lighting for a term of three years as follows: 150 2,000-c. p. arc lights at $78.75; 50 1,200-c. p. incandescent at $23.87; 50 32-c. p. incandescent at $17.52, the city reserving the right to increase the number of arc or incandescent lights as they may desire at the contract price per light.

The Toronto and Richmond Hill Street Railway Company are being sued for $20,000 damages by Thomas Armstrong, real estate agent, on the ground of damages to his property by the use by the company of the Forest Hill road. The plaintiff also asks for an injunction to restrain the company from further using the road, and for the disallowance of the township by-law granting the company a bonus of $20,000.

Mr. R. R. Dobell, president of the Canadian Atlantic Cable Company, has received an offer for laying the company's cable from a point at the Strait of Belle Isle to a point on the west coast of Ireland. A meeting of the Canadian directors is to be held shortly to consider the offer, and the Dominion Parliament will be asked to subsidize a direct cable connection between Canada and Great Britain. It is believed that the British Government will also assist the project.

Application has been made to the courts by the creditors to have the Consolidated Electric Co.; of Fredericton, N. B., put into liquidation. The solicitor for the company applies to have the application set aside on the ground that the court had not jurisdiction to make the order for the winding up of the company under the Winding Up Act, by reason of its being a railway company and exempt from the operation of the statute. The matter has been sent up for argument.

Incorporation is being asked for by the Preston and Berlin Street Railway Company, Ltd., to operate a line from Preston to Berlin, and connecting at Preston with the Galt and Preston road, and at Berlin with the Berlin and Waterloo Street Railway. The proposed capital stock is $100,000. The provisional directors are: Thomas Todd, Daniel Spiers, Wm. H. Sutz, of Galt; R. Gregory Cox, St. Catharines; T. M. Burt, Waterloo; Fred. Clare, Preston; John Fennell, Berlin, and R. G. Dickson, Niagara.

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SPARKS.

The Canadian Pacific Telegraph Company announce the opening of a telegraph line from Halifax to Sydeny, C. B.

The Fredericton Gas and Electric Light Co. have contracted to light the streets of the city for ten years at $55 per light per year.

The largest electric power generator in Canada is now being placed in the power house of the Ottawa Electric Street Railway Company, It is a 700 h. p. Westinghouse multipolar machine and weighs 37 tons.

The Vancouver *News* announces the arrival in that city of Mr. H. Pim, of Toronto, to succced Mr. E. Maxwell as manager of the General Electric Co.'s business. Mr. Maxwell has gone to Portland, Oregon.

The Westminster and Burrard Inlet Telephone Company propose to extend their line to the American boundary, and thus afford wire connection with Seattle, Tacoma, Spokane, Portland and San Francisco.

Bell Telephone stock is reported to be very strong, and little or none is obtainable in Montreal under 150. This stock which pays 2 per cent. quarterly, is said to be gradually passing into the hands of small investors.

It is stated by the manager that the Niagara Falls Park and River Railroad carried without accident last season, 354,000 passengers. The work of double tracking the line was commenced in September and is being rapidly pushed forward.

The Western Union Telegraph Company has been granted permission by the Canadian Customs Department to land, free of duty, at Canso, a part of cable to be used in repairing the Anglo-American cable, nine miles from Nova Scotia shore.

Mr. D. H. Keeley, Acting Superintendent Government Telegraphs, has just returned from the Gulf of St. Lawrence, having seen to the repair of the cables to the Magdalen Island and St. Paul's Island, as well as the laying of a new short line to Anticosti.

A 500 light plant has lately been installed by the Canadian General Electric Company at Lethbridge, N. W. T.

It is reported that an American Company is prospecting with a view to establishing an electric railway in Charlottetown, P. E. I.

The Hamilton City Council have adopted a by-law granting a bonus and right of way to the Hamilton, Grimsby and Beamsville Electric Railway. The promoters of the railway have secured the necessary right of way over almost the entire route, and have started men to work on the grading of the lines.

On the Montreal Park and Island Railway Company's lines, which are about completed, Mr. Roy, the Company's engineer, has caused to be used broken stone for the road beds. Cars of American pattern, 23 feet in length are to be used on this line. The following gentlemen were lately elected as the officers of the Company: Hon. Louis Beaubien, president; Hon. J. R. Thibaudeau, vice-president; Robt. L. Gault, treasurer; Maurice Perrault, secretary and assistant treasurer: David Morrice, Henry Hogan and M. S. Lonergan, directors.

The City Council of Ottawa refused to allow the North American Telegraph and Telephone Company to bring its wires into the city except by means of conduits, and then only on condition that the Company would pay to the city 6 per cent. of its gross receipts. The Company did not fall in with this proposition, but it is alleged, secured an entrance to the city by utilizing the poles of the Bell Telephone Company, the Standard Electric Company, and fire alarm poles. The City Engineer was instructed to at once remove the poles and wires attached to Corporation property, and that official carried out his instructions by cutting the Company's wires. The City Solicitor of Ottawa has given it as his opinion that the Bell Telephone Company have the right to allow other companies to string wires upon their poles and that the action of the North American Telegraph and Telephone Company in thus stringing their wires was legal.

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SPARKS.

The Winnipeg Electric Railway Company has recently reduced the wages of its employees by 20 per cent.

The Legal and Commercial Exchange reports the assignment of Messrs. Quintard & Packard, dealers in electrical supplies at Victoria, B. C.

The Toronto Railway Company have purchased a 250 h. p. Robb-Armstrong high speed engine, to be used as an auxiliary, during the winter, to their present power station.

An all night service has been inaugurated by the Bell Telephone Co. at Owen Sound, and negotiations are proceeding with the object of furnishing the town with an electric fire alarm system.

Parliament will be asked to grant incorporation to the Niagara Falls Electric Railway Bridge Company, to build a bridge across the Niagara River between the Falls and the Whirlpool sapids.

A 140 h. p. condensing engine and steel boiler, have been purchased by the Penetanguishene and Midland Light and Power Company, of Penetanguishene, for their power station, now in course of erection.

The first electric plant of the Waddell-Entz Company's manufacture has been installed in the *Gazette* Building at Montreal, by the Company's Canadian agents, Messrs. John Langton & Company, of Toronto. The plant comprises a 30 Kilowatt incandescent dynamo of the slow speed type, and a slate switch-board provided with volt meter and ammeter.

The London West Electric Railway went into operation on the 4th of November. The event was celebrated as a public holiday. The road is owned by the company which operates the horse car system in the city proper. There has been opposition on the part of some of the citizens and their representatives in the city council, to the granting of a franchise to the company for the city and the conversion of the city lines to electricity. It is expected that the new electric road in London West will serve to show the citizens the superiority of electricity, and aid the company in securing the city franchise.

When permission was granted the Merchants' Telephone Company, of Montreal, to erect poles on the streets of that city, it was supposed by the council that the resolution granting the privilege called for the work to be done under the supervision and control of the city engineer. It has turned out however that the wording of the resolution does not cover this point, and the telephone company are erecting poles in a manner to please themselves, and in some cases much to the disatisfaction of the citizens. This privilege granted to the Merchants' Company, will incidentally work to the advantage of the Bell Telephone Company also, as so long as one company is allowed to run its wires overhead, the other company will also escape the expense which would be entailed by putting their wires underground.

We learn from the annual report of Mr. Grenville C. Cunningham, chief engineer of the Montreal Street Railway, that the total mileage of the road when completed will be about 85 miles. 54½ miles of new track have already been laid, and it is expected that when winter sets in the whole system will have been laid with rails. 43 miles of overhead trolley have been constructed, and some 400 poles put up. There are in use at present 71 motor cars, each car being fitted with two 25 h. p. motors. By the time the winter sets in this equipment will have been increased to 100 motors and 4 snow sweepers. 2200 h. p. is at present being used, 1,000 h. p. being supplied by the Royal Electric Company, 1,000 h. p. by a temporary power station erected by the company, and 200 h. p. from the Montreal Exposition Company's engines. The new power station which the company are erecting on William street will afford a total of 3,200 h. p. It is expected that power from two engines from this station will be available before the end of the year. The engine house in connection with this new station is 235 feet long by 187 feet wide, and will contain six engines, each having a capacity of 600 h. p., and driving two kilowatt Edison generators. Sufficient space will be allowed in the building for two more engines. Water for condensing purposes will be obtained from the canal. A chimney 186 feet high by 9 feet interior diameter has been erected.

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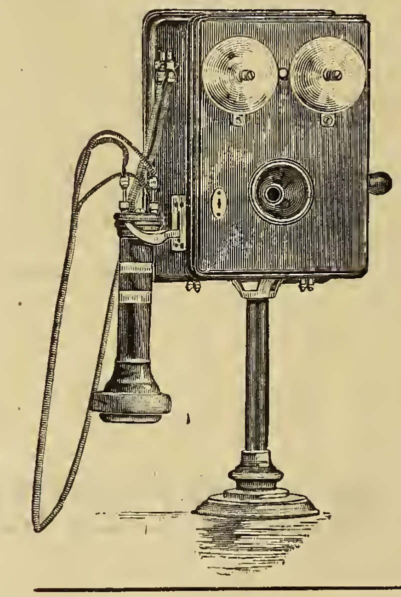

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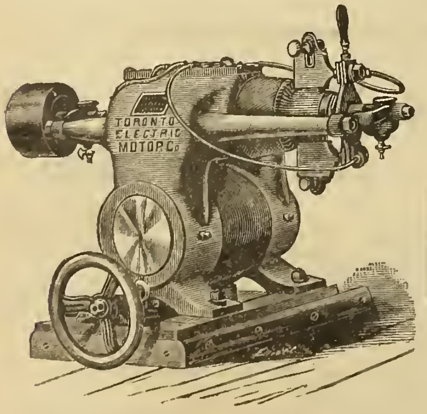

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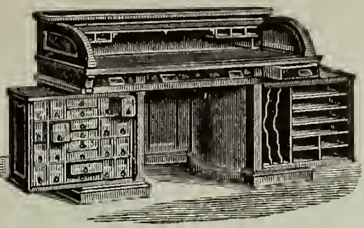

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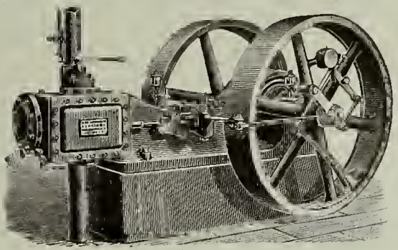

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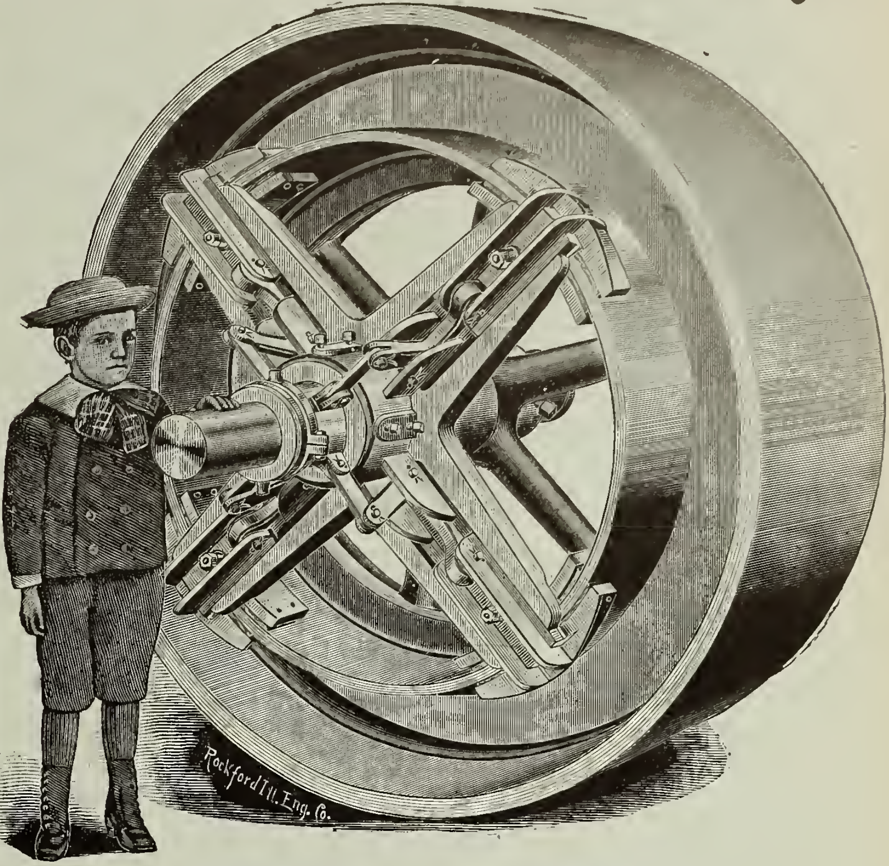

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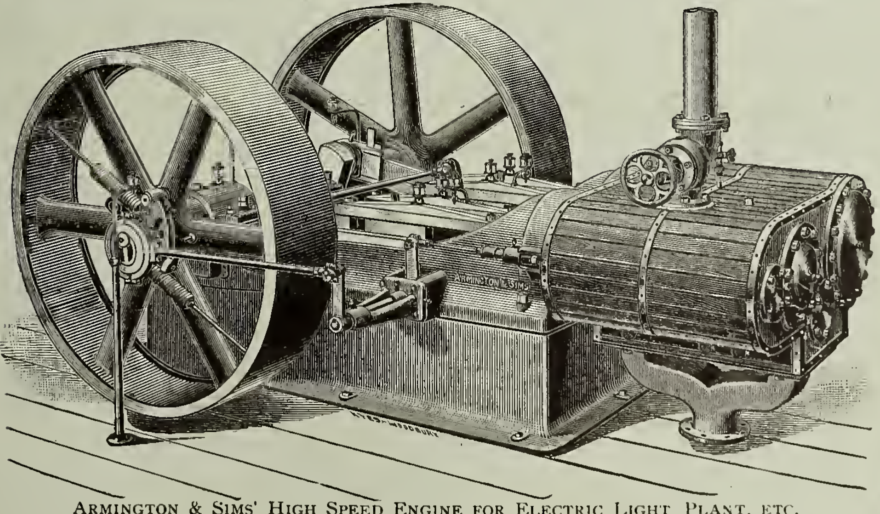

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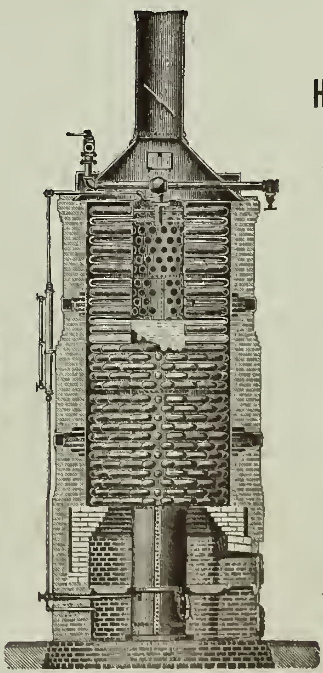

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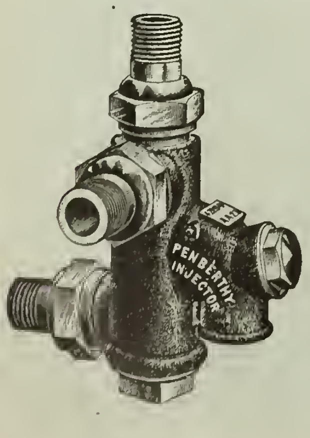

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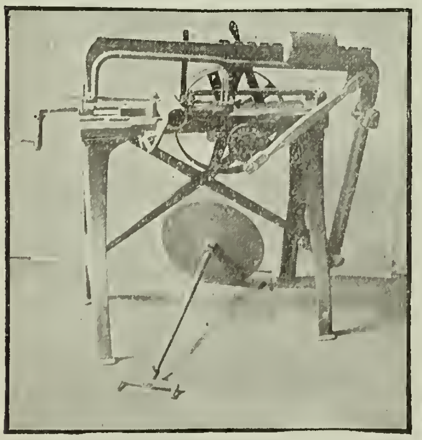

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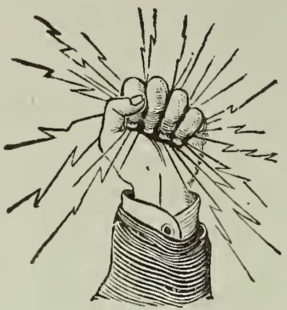

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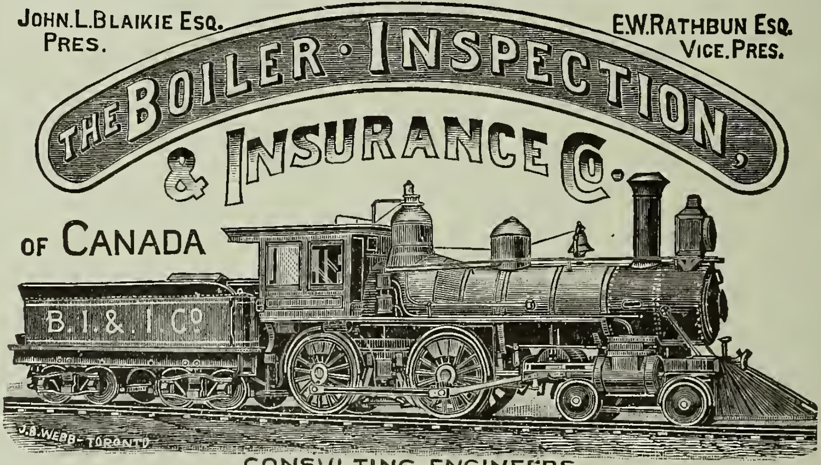
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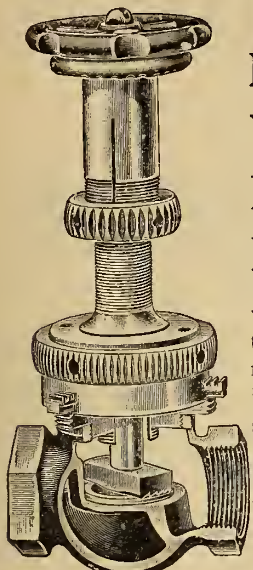

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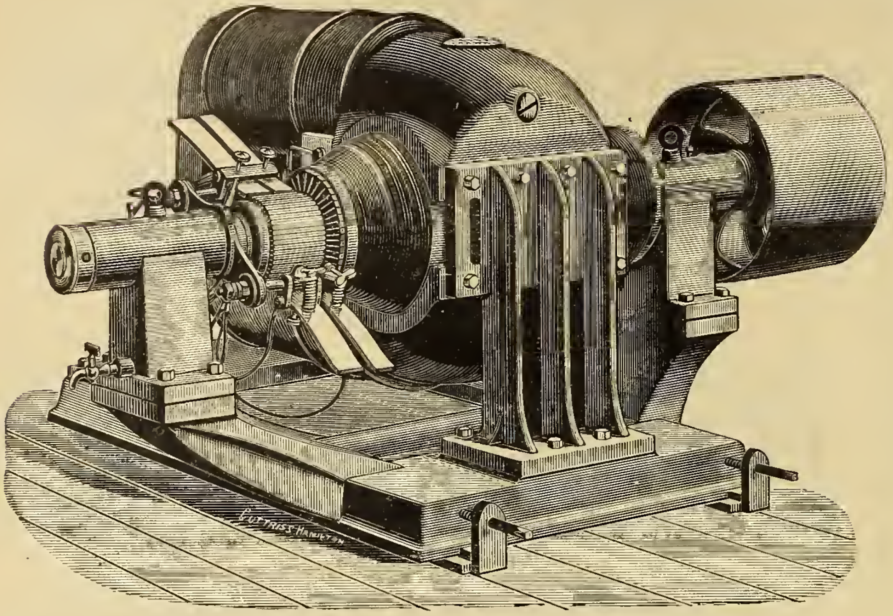

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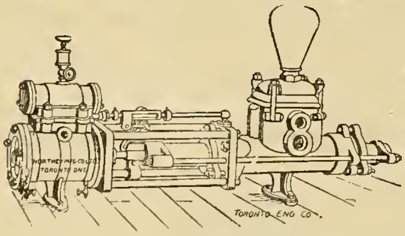
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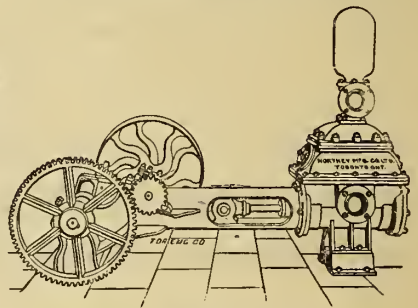
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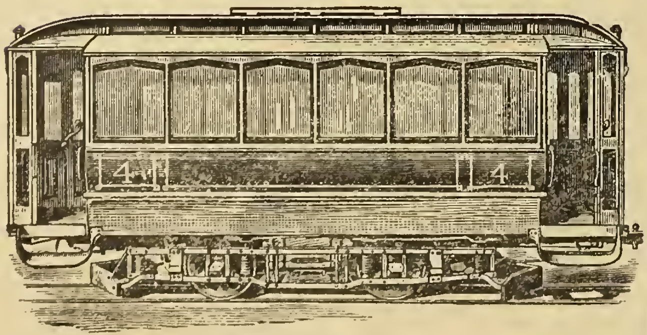

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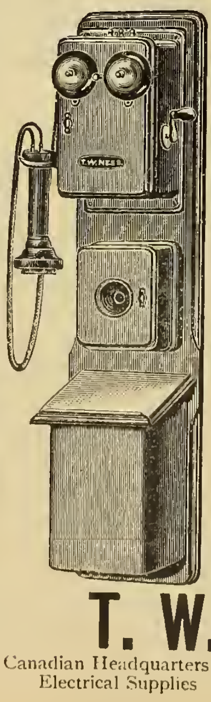

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CANADIAN
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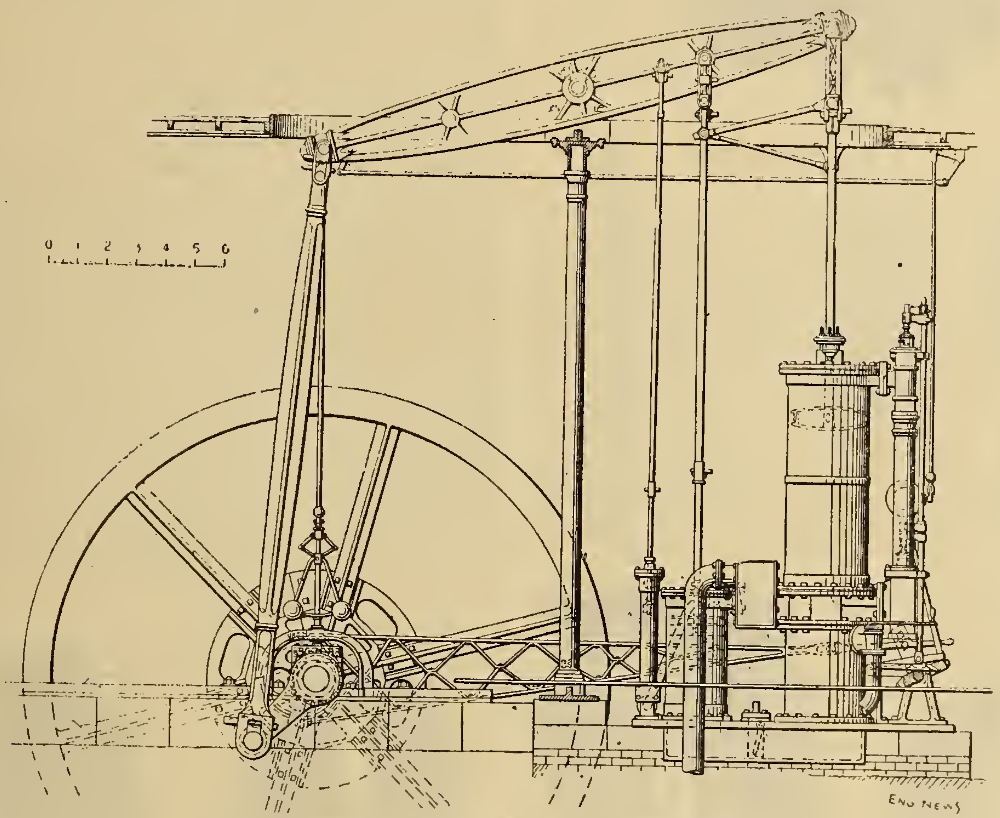
VOL. IV. JANUARY, 1894 NO. 1.

THE OLDEST STEAM ENGINE IN THE UNITED STATES.

The steam engine shown in the accompanying drawing was built in 1815, by James Watt, of Lancashire, England, according to the information furnished us. This probably means that it was built by the firm of Boulton & Watt, formed by the sons of the great inventor and his partner to succeed the original and famous firm of Boulton & Watt, which terminated its existence in the first year of the present century. The engine illustrated was brought to Savannah in 1815, and was set up in the rice mill of Messrs. McAlpin & McInnis. It has been at work regularly ever since and is still doing daily duty, having been put in good repair two years ago by the Novelty Iron Works, of Savannah.

The engine runs at about 18 revs. per minute and develops about 90 H. P. Its cylinder is 31 × 72 ins. and it uses steam at 8 lbs. pressure. The air pump and boiler feed pump are each worked from the beam of the engine. The crank, the shaft and the connecting rod are made of cast iron.

There is good reason to believe that this engine is the oldest steam engine in the United States that is still doing regular service, and it is quite possible that it is as old as any of those which are still preserved as curiosities. In 1803 (see Jour. Franklin Inst., October, 1876), there were only five steam engines in the United States, of which two were at Philadelphia, two in New York and one in Boston. Three of these were pumping engines.



THE OLDEST STEAM ENGINE IN THE UNITED STATES.

Remembering that in 1815 manufacturing industries were still confined to the thirteen original States, and that in any of the Northern States an old machine would be much more likely to be replaced by a new one than in the South, it seems altogether likely the oldest engine at work in the United States, or, for that matter, anywhere in the world, save in Europe. If there be an older one in existence we shall be pleased to make record of it. We are indebted to Messrs. John Rourke & Son, proprietors of the Novelty Iron Works, of Savannah, for the drawing from which our illustration is made and information given above.—*Engineering News.*

QUESTIONS AND ANSWERS.

D. W. M., Drumbo, Ont., writes: 1. Where would you advise one to go in order to receive a thorough practical electrical education? 2. What would be the cost of such an education? 3. What time would be required, and what would be the necessary qualifications? 4. Do you know of any college in Canada where they have a special course in Electrical Engineerings?

Answer—1. We cannot undertake to advise you as to where you should go in order to receive such an education as you mention. That is a matter which you must decide for yourself Some are of the opinion that such an education can be obtained apart altogether from scientific schools. Others believe that a scientific school education in electrical theory is what is required; and others, again, that such an education should combine a term in a scientific school with a year or two devoted to practical work in an electrical manufacturing establishment. We rather incline to agree with the latter opinion, and believe further, that an electrical education should be founded upon a thorough knowledge of engineering and mechanics. An eminent electrical authority recently made the somewhat startling statement that an electrical engineer should be one-tenth electrical and nine-tenths mechanical. We would advise our correspondent to read the paper read by Mr. Merrill before the Canadian Electrical Association at its last meeting, together with the discussion thereon. By this means he will learn the views of a number of persons prominently identified with the electrical business. 2. There is a course in Mechanical and Electrical Engineering at the School of Practical Science, Toronto, and at McGill University, Montreal. At Toronto the course extends over a period of three years, and the cost to the student, including the necessary books and instruments, is $250. 3. In order to enter upon this course students must have passed a University matriculation examination or a junior leaving examination at the High School. In case the student has had a year's experience at mechanical work in a manufactory, he will be admitted on passing a special examination in Mathematics and English.

MONTREAL ELECTRIC CLUB.

Dec. 4th.—At the regular meeting on this date, Mr. John Smillie read an entertaining paper on "Pioneer Electric Lighting in Montreal" for which he was given a vote of thanks. At the suggestion of a member, it was decided to have a question box in which the members could deposit questions which they desired to be answered.

Dec. 18th.—Mr. J. Gough delivered another of his series of papers on the "Philosophy, Application, Construction and Improvement of the Steam Engine," for which a vote of thanks was given him, debate was then held on "Alternate versus Continuous Current for Transmission for Power and Lighting a distance of Nine Miles." Messrs. H. W. Woodman and H. Ritchie supported the alternate current, and Messrs. W. B. Shaw and C. Legrand, continuous current. After an interesting debate in which the merits of each system were well set forth, the question was put to the meeting and was decided in favor of the alternate current by a small majority.

ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.

By Nikola Tesla.

(Continued.)

ON ELECTRICAL RESONANCE.

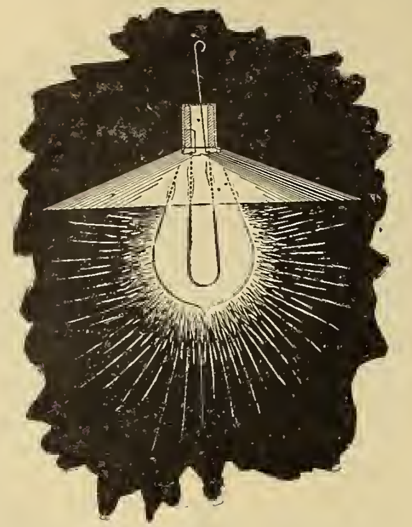


Fig. 24

Utilizing the Heating Effect of Conduction Current and Bombardment.

The effects of resonance are being more and more noted by engineers, and are becoming of great importance in the practical operation of apparatus of all kinds with alternating currents. A few general remarks may therefore be made concerning these effects It is clear, that if we succeed in employing the effects of resonance practically in the operation of electric devices, the return wire will, as a matter of course, become unnecessary, for the electric vibration may be conveyed with one wire just as well, and sometimes even better, than with two. The question first to answer is, then, whether pure resonance effects are producible. Theory and experiment both show that such is impossible in Nature, for as the oscillation becomes more and more vigorous the losses in vibrating bodies and environing media rapidly increase, and necessarily check the vibration which otherwise would go on increasing forever. It is a fortunate circumstance that pure resonance is not producible, for if it were there is no telling what dangers might not lie in wait for the innocent experimenter. But to a certain degree resonance is producible, the magnitude of the effects being limited by the imperfect conductivity and imperfect elasticity of the media, or generally stated, by frictional losses. The smaller these losses, the more striking are the effects. The same is the case in mechanical vibration. A stout steel bar may be set in vibration by drops of water falling upon it at proper intervals; and with glass, which is more perfectly elastic, the resonance effect is still more remarkable, for a goblet may be burst by singing into it a note of the proper pitch. The electrical resonance is the more perfectly attained, the smaller the resistance or the impedance of the conducting path, and the more perfect the dielectric. In a Leyden jar discharging through a short, stranded cable of thin wires these requirements are probably best fulfilled, and the resonance effects are, therefore, very prominent. Such is not the case with dynamo machines, transformers and their circuits, or with commercial apparatus in general in which the presence of iron cores complicates or renders impossible the action. In regard to Leyden jars with which resonance effects are frequently demonstrated, I would say that the effects observed are often attributed, but are seldom due, to true resonance, for an error is quite easily made in this respect. This may be undoubtedly demonstrated by the following experiment. Take, for instance, two large insulated metallic plates or spheres, which I shall designate A and B, place them at a certain small distance apart, and charge them from a frictional or influence machine to a potential so high that just a slight increase of the difference of potential between them will cause the small air or insulating space to break down. This is easily reached by making a few preliminary trials If, now, another plate—fastened on an insulating handle, and connected by a wire to one of the terminals of a high tension secondary of an induction coil, which is maintained in action by an alternator (preferably high frequency)—is approached to one of the charged bodies A or B, so as to be nearer to either one of them, the discharge will invariably occur between them; at least it will if the potential of the coil in connection with this plate is sufficiently high. But the explanation of this will soon be found in the fact that the approached plate acts inductively upon the bodies A and B, and causes a spark to pass between them. When this spark occurs, the charges which were previously imparted to these bodies from the influence machine must needs be lost, since the bodies are brought in electrical connection through the arc formed. Now, this arc is formed whether there be resonance or not. But even if the spark would not be produced, still there is an alternating E.M.F. set up between the bodies when the plate is brought near one of them; therefore, the approach of the plate, if it does not always, actually will, at any rate tend to break down the air space by inductive action. Instead of the spheres or plates A and B we may take the coatings of a Leyden jar with the same result, and in place of the machine, which is a high frequency alternator preferably, because it is more suitable for the experiment, and also for the argument, we may take another Leyden jar or battery of jars. When such jars are discharging through a circuit of low resistance the same is traversed by currents of very high frequency. The plate may now be connected to one of the coatings of the second jar, and when it is brought near to the first jar just previously charged to a high potential from an influence machine the result is the same as before, and the first jar will discharge through a small air space upon the second being caused to discharge. But both jars and their circuits need not be tuned any closer than a basso profundo is to the note produced by a mosquito, as small sparks will be produced through the air space, or at least the latter will be considerably more strained owing to the setting up of an alternating E.M.F. by induction, which takes place when one of the jars begins to discharge. Again, another error of similar nature is quite easily made. If the circuits of the two jars are run parallel and close together, and the experiment has been performed of discharging one by the other, and now a coil of wire be added to one of the circuits whereupon the experiment does not succeed, the conclusion that this is due to the fact that the circuits are now not tuned would be far from being safe. For the two circuits act as condenser coatings, and the addition of the coil to one of them is equivalent to bridging them, at the point where the coil is placed, by a small condenser, and the effect of the latter might be to prevent the spark from jumping through the discharge space by diminishing the alternating E. M. F. acting across the same. All these remarks, and many more which might be added but for fear of wandering too far from the subject, are made with the pardonable intention of cautioning the unsuspecting student, who might gain an entirely unwarranted opinion of his skill when seeing every experiment succeed; but they are in no way thrust upon the experienced as novel observations.

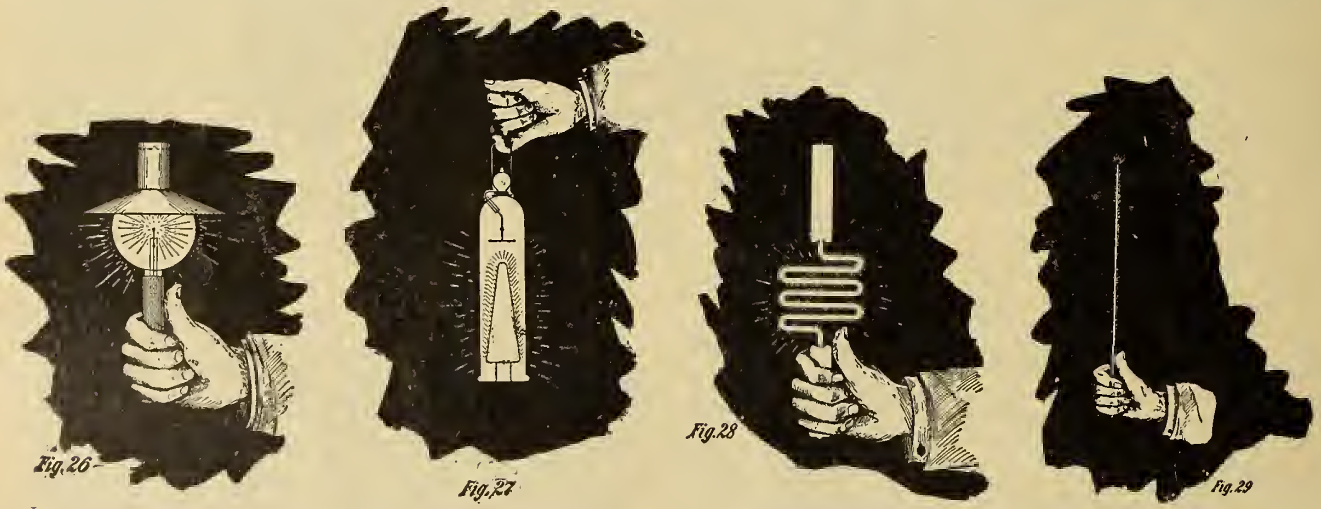


Fig. 26

Incandescence of a Solid.

Fig. 27

Phospherence.

Fig. 28

Incandescence or Phospherence or Rarefied Gas.

Fig. 29

Luminosity of Gas at Ordinary Pressure.

FOUR KINDS OF LIGHT EFFECTS BY HIGH FREQUENCY CURRENTS OF HIGH POTENTIAL.

In order to make reliable observations of electric resonance effects it is very desirable, if not necessary, to employ an alternator giving currents which rise and fall harmonically, as in working with make and break currents the observations are not always trustworthy, since many phenomena, which depend on the rate of change, may be produced with frequencies widely different. Even when making such observations with an alternator one is apt to be mistaken. When a circuit is connected to an alternator there are an infinite number of values for capacity and self-induction which, in conjunction, will satisfy the condition of resonance. So there are in mechanics an infinite number of tuning forks which will respond to a note of a certain pitch, or loaded springs which have a definite period of vibration. But the resonance will be most perfectly attained in that case in which the motion is effected with the greatest freedom. Now in mechanics, considering the vibration in the common medium—that is, air—it is of comparatively little imporance whether one tuning fork be somewhat larger than another, because the losses in the air are not very considerable. One may, of course, inclose a tuning fork in an exhausted vessel, and by thus reducing the air resistance to a minimum obtain better resonant action. Still the difference would not be very great. But it would make a great difference if the tuning fork were immersed in mercury. In the electrical vibration it is of enormous importance to arrange the condition so that the vibration is effected with the greatest freedom. The magnitude of the resonance effect depends, under othewise equal conditions, on the quantity of electricity set in motion or on the strength of the current driven through the circuit. But the circuit opposes the passage of the currents by reason of its impedance, and, therefore, to secure the best action it is necessary to reduce the impedance to a minimun. It is impossible to overcome it entirely, but merely in part, for ohmic resistance cannot be overcome. But when the frequency of the impulses is very great, the flow of the current is practically determined by self-induction. Now self-induction can be overcome by combining it with capacity. If the relation between these is such that at the frequency used they annul each other, that is, have such values as to satisfy the condition of resonance, and the greatest quantity of electricity is made to flow through the external circuit, then the best result is obtained. It is simpler and safer to join the condenser in series with the self-induction. It is clear that in such combinations there will be, for a given frequency, and considering only the fundamental vibration, values which will give the best result, with the condenser in shunt to the self-induction coil; of course, more such values than with the condenser in series. But practical conditions determine the selection. In the latter case in performing the experiments one may take a small self-induction and a large capacity or a small capacity and a large self-induction, but the latter is preferable, because, it is convenient to adjust a large capacity by small steps. By taking a coil with a very large self-induction, the critical capacity is reduced to a very small value and the capacity of the coil itself may be sufficient. It is easy, especially by observing certain artifices to wind a coil through which the impedance will be reduced to the value of the ohmic resistance only, and for any coil there is, of course, a frequency at which the maximum current will be made to pass through the coil. The observation of the relation between self-induction, capacity and frequency is becoming important in the operation of alternate current apparatus, such as transformers or motors, because by a judicious determination of the elements the employment of an expensive condenser becomes unnecesary. Thus it is possible to pass through the coils of an alternating current motor under the normal working conditions the required current with a low E. M. F. and do away entirely with the false current, and the larger the motor the easier such a plan becomes practicable; but it is necessary for this to employ currents of very high potential or high frequency.

In Fig. 20 I is shown a plan which has been followed in the study of the resonance effects by means of a high frequency alternator. C is a coil of many turns, which is divided in small separate sections for the purposes of adjustment. The final adjustment was made sometimes with a few thin iron wires (though this is not always advisable), or with a closed secondary. The coil C is connected with one of its ends to the line L from the alternator G, and with the other end to one of the plates c of a condenser c c_1, the plate (c^1) of the latter being connected to a much larger plate P_1. In this manner both capacity and self-induction were adjusted to suit the dynamo frequency.

As regards the rise of potential through resonant action, of course, theoretically, it may amount to anything since it depends on self induction and resistance, and since these may have any value. But in practice one is limited in the selection of these values, and besides these, there are other limiting causes. One may start with, say, 1,000 volts, and raise the E. M. F. to 50 times that value, but one cannot start with 100,000 and raise it to 10 times that value, because of the losses in the media, which are great, especially if the frequency is high. It should be possible to start with, for instance, two volts from a high or low frequency circuit of a dynamo, and raise the E. M. F. to many hundred times that value. Thus coils of the proper dimensions might be connected each with only one of its ends to the mains from a machine of low E. M. F., and though the circuit of the machine would not be closed in the ordinary acceptance of the term, yet the machine might be burned out if a proper resonance effect would be obtained. I have not been able to produce nor have I observed with currents from the dynamo machine, such great rises of potential. It is possible, if not probable, that with currents obtained from apparatus containing iron, the disturbing influence of the latter is the cause that these theoretical possibilities cannot be realized. But if such is the case, I attribute it solely to the hysteresis and Foucault current losses in the core. Generally it was necessary to transform upward, when the E. M. F. was very low, and usually an ordinary form of induction coil was employed, but sometimes the arrangement illustrated in Fig. 20 II has been found to be convenient. In this case a coil C is made in a great many sections, a few of these being used as the primary. In this manner both primary and secondary are adjustable. One end of the coil is connected to the line L_1 from the alternator, and the other line, L, is connected to the intermediate point of the coil. Such a coil with adjustable primary and secondary will be found also convenient in experiments with the disruptive discharge. When true resonance is obtained, the top of the wave must, of course, be on the free end of the coil, as, for instance, at the terminal of the phosphorescence bulb B. This is easily recognized by observing the potential on a point on the wire w nearer to the coil.

In connection with resonance effects and the problem of transmission of energy over a single conductor, which was previously considered, I would say a few words on a subject which constantly fills my thoughts, and which concerns the welfare of all. I mean the transmission of intelligible signals, or perhaps even power, to any distance without the use of wires. I am becoming daily more convinced of the practicability of the scheme; and though I know full well that the great majority of scientific men will not believe that such results can be practically and immediately realized, yet I think that all consider the developments in recent years by a number of workers to have been such as to encourage thought and experiment in this direction. My conviction has grown so strong that I no longer look upon this plan of energy or intelligence transmission as a mere theoretical possibility, but as a serious problem in electrical engineering, which must be carried out some day. The idea of transmitting intelligence without wires is the natural outcome of the most recent results of electrical investigations. Some enthusiasts have expressed their belief that telephony to any distance by induction through the air is possible. I cannot stretch my imagination so far, but I do firmly believe that it is practicable to disturb by means of powerful machines the electrostatic condition of the earth and thus transmit intelligible signals and perhaps power. In fact, what is there against the carrying out of such a scheme? We now know that electric vibration may be transmitted through a single conductor. Why then not try to avail ourselves of the earth for this purpose? We need not be frightened by the idea of distance. To the weary wanderer counting the mile posts the earth may appear very large, but to that happiest of all men, the astronomer, who gazes at the heavens and by their standard judges the magnitude of our globe it appears very small. And so I think it must seem to the electrician, for when he considers the speed with which an electric disturbance is propagated through the earth all his ideas of distance must completely vanish.

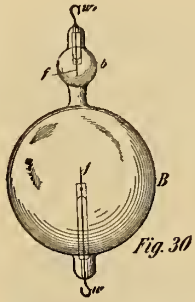


Fig. 30

Showing the Effect of Confining the Gas Around the Electrode.

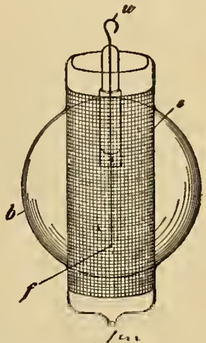


Fig. 31

Showing the Ineffiency of a Metal Screen.

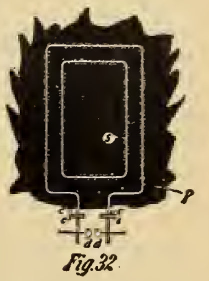


Fig. 32

Electrostatic Action Between Primary and Secondary, with Extremely High Frequencies.

A point of great importance would be, first, to know what is the capacity of the earth and what charge does it contain if electrified? Though we have no positive evidence of a charged body existing in space without other oppositely electrified bodies being near, there is a fair probability that the earth is such a body, for by whatever process it was separated from other bodies—and this is the accepted view of its origin—it must have retained a charge, as occurs in all processes of mechanical separation. If it be a charged body insulated in space its capacity should be extremely small, less than one-thousandth of a farad. But the upper strata of the air are conducting, and so, perhaps, is the medium in free space beyond the atmosphere, and these may contain an opposite charge. Then the capacity might be incomparably greater. In any case it is of the greatest importance to get an idea of what quantity of electricity the earth contains. It is difficult to say whether we shall ever acquire this necessary knowledge, but there is hope that we may, and, that is, by means of electrical resonance. If ever we can ascertain at what period the earth's charge, when disturbed, oscillates with respect to an oppositely electrified system or known circuit, we shall know a fact possibly of the greatest importance to the welfare of the human race. I propose to seek for the period by means of an electric oscillator, or a source of electric alternating currents. One of the terminals of the source would be conected to earth as, for instance, to large surface.

(To be Continued.)

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of the various Associations are requested to forward us matter for publication in this Department not later than the 20th of each month.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

A meeting of the Executive Board of the above Association was held a fortnight ago in Shaftesbury Hall, Toronto. There were present: A. E. Edkins and A. M. Wickens, Toronto; Robert Dickenson and R. Mackie, Hamilton; A. Ames, Brantford; James Devlin, Kingston; Fred. Mitchell, London, and S. Potter, Peterboro'. It was decided that in view of the feeling existing throughout the Province, an effort should be made to induce the Legislature at its next session to amend the present Engineers' License Act in such a way as to make it compulsory on all persons in charge of steam plants, other than farm engines or very small plants, to give proof of their ability to safely manage the same.

MONTREAL NO. 1.

At the last regular meeting of the above Association a resolution of condolence with the family of the late Mr. W. Wilson, a member of the Association, who was recently killed at the rolling mills, was passed.

Mr. Peter H. Cowper, mechanical superintendent of the Canadian Rubber Co., recently presented to Montreal Association No. 1 a model of a steam pumping engine made by himself, the cylinder of which has a small glass window through which the action of the water can be seen. Views of the engines of the Steamship Lucania were also presented to the Association by Mr. Hugh Vallance.

HAMILTON ASSOCIATION NO. 2.

The meetings of this Association of late have been of a particularly interesting and instructive character, especially the one held on the 15th of December, on which occasion Bro. Peter Stott read a valuable paper on "Centrifugal Force," illustrating the same in an able manner. The Association has appointed a committee to provide papers and subjects for discussion at the monthly open meetings throughout the winter, and I think other Associations would find it to their advantage to do the same.

WM. NORRIS, Rec.-Sec.

OTTAWA NO. 7.

A member of the above Association, under the *nom de plume* of "Progress," writes: On December 12th Ottawa No. 7 held its regular meeting, with the President, Bro. J. H. Thompson, in the chair. Although a small number of engineers were present, it turned out to be one of the most interesting and instructive meetings since organization. The routine business is generally over in a short time, as every member is anxiously waiting for "Good of the Order," either to take part or get information from discussions on engineering.

The subject taken up was "The best methods of firing coal." At first the question did not receive much attention, but when some experienced hands stirred it up, it was clear to everyone to be of the most vital importance to engineers and steam users—for the employer should appreciate the services of the man that will run his plant the most economically—and as the fuel bill plays a prominent part in connection with the expenses of an engineer's department, it was elaborately demonstrated that every engineer should necessarily be thoroughly acquainted with different kinds of fuel and how to treat them during combustion.

Some veteran firemen drew attention to the large amount of fuel wasted in cleaning out a fire, when one made a suggestion to that effect. He said the general way is to shove the good coals off the clinkers to the back of the furnace, and rake the front out, and then pull the good coals from the back on the uncovered bars to the front. At this point he explained the advantage of having a layer of green coal on the front of the bars before drawing over the hot coals; it prevented a vast amount of combustible from dropping into the ash pit, to be afterwards thrown away as refuse.

After this question had been made as explicit as possible under the circumstances, Bro. Peters said he had experienced some difficulty in keeping up steam, and wanted to know if the cause should be attributed to some alterations made in the furnace. In answer to questions as to the grate and heating surfaces, and the construction of the bridge-wall, he said the latter was 7″ or 8″ from boiler, when it was suggested that he should put in another course of bricks to make it 4″ or 5″, which would keep the flames in closer contact with the boiler.

At this point Bro. Merrill went to the blackboard to make a rough sketch of boiler setting, showing the bridge wall, and that the flooring should be built parallel to the boiler or closed in towards the back end.

To this Bro. Robert took an opposite view, saying that from the bridge wall the floor should be sloping down to the back, so as to form a good combustion chamber, and more especially when soft coal is used; and the distance between bridge wall and boiler should in no case be less than ten inches. In his opinion a bridge wall was never intended to steer the gases against the boiler, but simply to form the back of the furnace, and retain the coal upon the grate. In support of his contention he quoted some good authorities.

Bro. Wensley endorsed this view, but as there is a wide difference of opinion, some thought it should be left open to a fair criticism by engineers of other Associations or by any one interested in engineering.

Before the meeting was closed the President gave notice of a special meeting on December 14th, at which Mr. Thomas Stewart, Chief Mechanical Engineer for Messrs. McLaughlin Bros., of Arnprior, was admitted to membership. Ottawa No. 7 feels proud to be able to boast of such an acquisition, as Mr. Stewart is widely known to be an indefatigable worker for the cause and welfare of engineers.

At our next and last meeting in December there will be two more initiations, and we will also elect our officers for 1894.

The London Association will in future hold its meetings on the first Thursday and last Friday of each month. Mr. William Meaden, 533 Richmond Street, has been elected secretary, *vice* Mr. George Taylor.

ENGINES FOR ELECTRICAL WORK.

Editor CANADIAN ELECTRIAL NEWS.

DEAR SIR:—Mr. W. T. Brown's letter of the 15th November on the subject of engines gives one the impression that he considers the long stroke engine challenged, and feels called upon to defend it, as opposed to the short stroke engine. I am sorry if Mr. Brown or others of your readers have construed my letter, in your November number, as either condemning the long stroke engine in a general sense, or advocating the high speed engine as superior to it for all circumstances. I frankly stated that the long stroke engine will give somewhat better economy than the high speed engine under best conditions as to the amount and regularity of load; but you will remember that my letter was called forth by your article treating of engines for Electric Railway work, and I attempted to discuss the special features of the high speed engine, particularly with reference to this kind of work. In regard to the long stroke engine, I will go further, in order to leave no doubt as to my position in the matter, and say that I believe there are circumstances where, the work being steady and regular in amount, speed of the driven gearing slow and space unlimited, the slow speed engine may be better adapted to the work than the high speed engine, as at present constructed. But I think it is now pretty generally, if not universally conceded by the best authorities on steam engineering that the best high speed engines have reached a state of perfection where they may be selected for such circumstances as they are adapted to, without fear of failure either from excessive wear or breakage. In confirmation of this, I will make only one or two references, although a great many more could be given.

1st. I would refer your readers to a report, read at the Milwaukee Convention of the Street Railway Association, by a committee consisting of E. G. Connette, L. H. McIntyre, and F. S. Pearson, appointed to report on power house engines, an abstract of which may be found in the *Electrical World* of October 28th, 1893. These gentlemen have all had extensive experience in engines for electric work and are apparently unbiased, as their reports show. They say "for small plants to run from ten to fifteen cars, simple high speed engines, belted direct to generators, are unquestionably the proper choice. For twenty to fifty car plants, compound engines, with condensing apparatus where it is possible; with tandem compound engines for the smaller plants, and cross-compound engines for the larger ones, geared direct to generators, will probably be found most economical; while for the larger systems compound and triple expansion condensing engines, using steam at a high initial pressure, and either driving a countershaft or coupled direct to generator, whichever the conditions of the case will warrant, will befound a proper selection." It will be noted that while high speed engines are distinctly recommended for small plants, and for medium size plants, engines geared direct to generator, which must necessarily be either high speed or medium speed, and even for very large plants a choice is left open to engines either belted to countershaft, which presumably would be low speed, or direct connected to generator, which would be high or medium speed.

2nd. I would refer to a paper read by Mr. Charles H. Emery, Ph.D., before the seventy-fifth meeting of the American Institute of Electrical Engineers on "The Cost of Steam Power Produced with Engines of Different Types Under Practical Conditions," and a lecture by the same author before the Sibley College on "The Cost of Steam Power," an abstract of which may be found in the *Electrical World* of April 1st, 1893. This paper is a very complete estimate, based on practical experience, of producing 500 H. P. for one year with eleven different types of engines, embraeing simple, compound, and triple expansion. condensing and non-condensing, both high speed and low speed, and includes the first cost of engines, boilers, and foundations, cost of fuel with various grades of coal, and repairs, insurance and interest. In regard to the item of repairs Dr. Emery makes the difference in cost between high and low speed engines 43 cents per horse power per year in favor of the low speed, or not quite 1 per cent on the total cost per horse power per year for 365 days, for electric railway plants, with coal at $3.00 per ton, and it may be that the results are not taken from the best high speed engines, as there are many inferior ones in use, probably more than of the low speed, owing to its earlier and more perfect development. The total cost of producing a horse power for one year to the various classes of engines, including first cost, wear and tear, fuel, attendance, and other items, while it shows that the low speed engine in each class will produce a horse power slightly cheaper than the high speed engine of the same class, also shows that a high speed non-condensing compound is cheaper in first cost and total cost per horse power, including wear and tear, fuel, etc., than a low speed simple engine; and a high speed compound condensing engine is cheaper in first cost and running expenses than a low speed simple condensing engine; and a high speed triple compound condensing is cheaper in first cost and total running expenses than a slow speed compound condensing engine, so I think it is safe to say that the choice of engines should be entirely regulated by the conditions of the case, as it is evident that under some circumstances it may be cheaper and better to use high speed engines, while under others it would be better to have slow speed ones.

Now just a few words in reference to some of the arguments used by Mr. Brown in criticism of my previous letter. He admits: "it is true that the high speed engine has more opportunities to correct the difference of speed caused by various loads," than the low speed engines, but he says, "it needs them all on account of the lightness of its parts." I am at a loss to understand just what he means by this. Does he mean that the piston, crosshead, connecting rod, or crank are lighter, and therefore have less balancing power? If so I would remind him that it is not simply the weight but the inertia of the reciprocating parts that affects the balancing or steadiness of an engine while in motion. Inertia is a result of both weight and speeds and as the high speed engine usually has greater inertia of moving parts, it has better balancing qualities than a slow speed engine. Does he mean the balance wheel? If so, the high speed engine has that in its favor too, because, while the wheel or wheels, of a high speed engine are much smaller and lighter than in a slow speed engine, their higher rate of speed gives them more balancing power. If he will take the trouble to make the calculation, he will find, that a wheel or wheels six feet in diameter, weighing say 4000 lbbs. running at 250 revolutions per minute, will have considerable more balancing power than a wheel thirteen feet in diameter, weighing say 9000 lbs., running 60 revolutions per minute.

Mr. Brown next advises me to make proper enquiries and I "will find that there are slow speed engines which have very sensitive governor attachments, regulating very closely," etc. I am pleased to say I have seen a large number of long stroke engines with good governors, regulating as closely as long stroke engines are capable of regulating, but I have not yet seen any that, when called upon to run street railway generators, where the load varies from 100 to 500 per cent. in less than one revolution of the engine, as it frequently does in small plants, would regulate closely at all; and it is self-evident that an engine running say 60 to 80 revolutions per minute with trip cut-off cannot be made to do it. The writer next advises me to take a trip to the United States to find "that in a great many cases the high speed engines have been removed to make room for the low speed ones; it is not uncommon to find electric light and power stations where they removed two and even three high speed engines to put in one low speed, and by doing so have saved nearly one-half of their boiler capacity," and he concludes that the change is made that they may have better economy and fewer repairs. I think he is perfectly right in his conclusion, so far as economy is concerned, and I do not think it will be necessary to go to a foreign country to see examples of the same procedure, with the same result, because it is perfectly well known that one large engine, of either the high or slow speed type, will do better than a number of small engines, if the load is fairly uniform and suited to the larger engine, and there are many cases, not only in electric plants but for other purposes, where small engines have been replaced by larger engines, as the work increased and the requirements became better known, and it will continue to be so. This goes to support my contention that each class of engine has special advantages for certain cases. I have in my mind a case where a competent expert, after making careful tests of an electric plant, advised laying aside a long stroke engine and using two high speed ones, although this is perhaps exceptional, because when the change is made it is usually in the direction of using larger units of power under more uniform load.

Mr. Brown states that excessive clearance is the cause of considerable loss in the high speed engine, and he is probably correct in regard to many of the high speed engines in use, but it may not be out of place to say that this is overcome to a considerable extent by a higher compression than is possible in the slow speed engine, and the latter designers of high speed engines have managed to lessen the clearance to a very small amount without contracting the port area. I have in mind a high speed engine which has less than 5 per cent. of clearance, and the compression reaches very close to the initial pressure, so that the loss from this source cannot be very great.

Mr. Brown, in this connection, finds fault with the excessive compression necessary to insure quiet running in a high speed engine. Now 1st, I do not see how he makes out that high compression affects economy adversely. I think it is generally understood that high compression fills the clearance spaces with steam which otherwise would be wasted, and tends to equalize the temperature in the cylinder. In regard to its being necessary to insure quite running, I believe that is generally thought to be a good feature. It cushions the piston and reciprocating parts, lessens the strain on the crank pin bearings while turning the centres, and I believe has exactly the same effect in the long stroke engine as in the high speed one, and if, as Mr. Brown states farther on in his letter, the piston speed may be the same in both engines, the compression would require to be the same also, to balance the inertia of the reciprocating parts and to insure quiet running in both engines; but, as a matter of fact, the piston speed is usually greater in the high speed engine than in the long stroke, Corliss type, and consequently the compression may be higher, which is thought to be an advantage both in economy of steam, and wear and tear of engine, because it is possible to more nearly relieve the strain on the bearings while turning centres.

Mr. Brown next concludes that the fast motion of the high speed engine must of necessity cause more wear than there is on the same parts of the slow speed, and makes a short extract from Mr. Chas. T. Porter's paper on the "Limitations of Engine Speed," to back up his statement. Now I think a little consideration will convince any one that, as I stated and explained in my previous letter, high rotative speed is not in itself a cause of wear, and if Mr. Brown or any one else, will take the trouble to read Mr. Porter's paper throughout he will find that Mr. Porter states clearly in his first sentence that, "the practical limitation to high rotative speed in stationary reciprocating steam engines *is not found in the danger of heating or of excessive wear.*" The cause of both of these, he continues to say "it is now well understood are to be looked for in defects of design or construction, commonly both." Following the same line, Mr. Porter says "correct designs are now generally followed in both the fixed and moving parts of steam engines, and a higher degree of truth is readily attained in their construction; so that it has come to be a simple matter to make engines which can be run at very high speeds quite free from either of these difficulties." In regard to smooth running and high compression, Mr. Porter says, "again an objection to very high speed is not found in a tendency to knock on centers. In a properly designed and constructed engine, in which valves are correctly set, and which is run by steam, high speed tends to silent running." Mr. Porter takes pride in the fact that high speed has revealed defects in design and construction, and has wrought an entire change in engine construction not yet completed, and he says "even makers of slow speed engines have profited from them." I am sorry to say that the makers of high speed engines in Canada, with one or two exceptions, have not profited as largely by this experience as they might; I hope the low speed men have. Now since I have quoted so largely from Mr. Porter's excellent paper, which is quite in keeping with his past record, and is undoubtedly, as Mr. Brown says, "the matured opinion of one of the ablest consulting engineers of the present day." I suppose it will only be fair to state what he considers the limitation to engine speed to be, if it is not wear, heating, etc. Well, he thinks it is limited by excessive clearance, and while he holds that high speed engines may be run at very much higher speeds than they are, so far as wear or heating is concerned, advises makers not to exceed 600 feet per minute piston speed for ordinary sizes of engines, which, as he says, will give 300 revolutions per minute with 12 inch stroke, and which I may say is quite as fast as the best makers of high speed engines care to run them at present, and with which speed Mr. Porter thinks purchasers ought to be satisfied.

Now at the close we come to the sentence quoted by Mr. Brown to prove that the high speed engine is ruled out, and that even Mr. Porter, the unfortunate father of said engine, has disowned it. Mr. Brown quotes as follows: "I would ask builders in their own interest to resist the temptation to get the utmost out of a given engine and set their faces like flint against the demand for short stroke engines which will occupy but little room." How can this fit in after all that Mr. Porter has said in favor of high speed, so far as I have quoted? Well, Mr. Brown did not quote the whole sentence; I will finish it. It is as follows: "And from which the power can be got by speeding up beyond the limit here proposed." The limit here proposed, as you will observe from the quotation which I have given in a previous paragraph, is 300 revolutions for an engine with 12 inch stroke, which is the ordinary speed of a high speed engine of that size.

Yours truly, D. W. ROBB.

ENGINES FOR ELECTRICAL WORK.

Editor ELECTRICAL NEWS.

SIR:—I have read an article in your paper on the relative merits of high speed vs. slow speed engines, for electrical purposes. Although the article referred to appears to be a well reasoned one from the standpoint of those building and favoring high speed engines, I cannot agree with them, as my experience for some time past while following my business is the reverse of theirs. Having no interest in any engineering firm, and having no engine to dispose of, I might be expected to give an unbiassed opinion of what has come under my observation.

Some two weeks ago, Mr. St. John, late Marine Engineering Inspector to the Dominion Government, Mr. Smeaton, Chief Engineer of the Steamship "Modjeska", holding a first-class engineer's certificate, and the writer, conducted a test in the power house of the Hamilton Electric Street Railway, of a compound condensing tandem Corliss engine, built by John Inglis & Son, Toronto. The cylinders are H. P. 16″ × 36″; L. P. 30″ × 36″; revolutions, 88; pressure of steam, 100 lbs.; vacuum, 25″ to 26″; (I may say that the Hamilton Street Railway is one of the best equipped on the continent the company having spared no expense to have it so throughout). The test of this engine extended over ten hours, 88 diagrams having been taken during its continuance, showing a large and immediate change in the power as the work came on and off it, varying from 80 to 230 H. P., yet not the slightest variation could be detected in its speed from a friction load with current switched off, or the whole load of say 230 I. H. P. The average load taken from the cars figured up to 190 H. P. The fuel burned in the ten hours of the test (equal quantities of hard and soft coal screenings) weighed 3,374 lbs. or rather less than 1¾ lbs. per I. H. P. per hour. Every care was taken in this test, considering the fluctuation of the load, to arrive at a fair result. It can not but be considered an excellent one; I know of nothing better, even with the best fuel.

There is another compound high pressure engine in this city running the Hamilton Colored Cotton Mills, and indicating 200 H. P. very nearly equally divided between each cylinder. This engine too has a very variable load, yet no difference can be detected in its motion. It also is fired with hard and soft coal screenings, burning 2⅓ lbs. per H. P. per hour; yet the exhaust from the engine heats the whole of the large mill, heats the water in the dye house to 180° Fr. and heats the large drying rooms also.

I could mention many others, perhaps not so economical of fuel but as regular in their motion. I do not know of any high speeds that will approach this compound condensing or otherwise. I know of several Armington & Sims engines taking 4½ lbs. per I H. P. per hour, and also of others of another make using up more than this; they also use up very much more oil than the long stroke engine and require to be much more carefully looked after. I know of several high speed engines that were taken out and replaced with long stroked automatic, but I never knew of the long stroke being superseded by the short stroke ones; in fact the whole tendency of electrical engineering at the present day is towards larger machines and slower speeds.

Yours respectfully, J. H. KILLEY.

PERSONAL.

Mr. J. C. Gough has just received the appointment of Mechanical Supt. for the Richelieu and Ontario Navigation Co., with headquarters at Sorel, P.Q.

Mr. Henry Goebel, whose name has of late figured prominently in the United States Courts as claiming to be the original inventor of the incandescent lamp, died at his residence in New York City on the 4th of December. Henry Goebel was born in the village of Springer, near Hanover, Germany, on the 20th of April, 1818, and arrived in New York in the early part of 1849.

The death is announced at Placentia, Newfoundland, of Mr. George M. Carson, manager and electrician of the cable borneat that place. Mr. Carson was in Pictou, August 16, 1847. At the age of 13 he entered the telegraph office in Pictou, later he worked in the Sackville office, Nova Scotia; thence he went to Heart's Content, Newfoundland, in 1867; to St. Pierre in 1870, and to Placentia in 1872, where he continued till his death.

Mr. F. E. Handy, who about a year ago was appointed superintendent of the New Westminster and Vancouver Tramway Company, is at present in Ontario, having been granted three months leave of absence to enable him to recuperate his health which has been affected by the dampness of the climate at Vancouver. We notice by the local press of Vancouver that Mr. Handy has been eminently successful in his management of the Westminster and Vancouver road, and it is the hope of his friends in British Columbia as well as in Ontario that he may speedily regain his health.

Mr. Benjamin B. Toye, Great North-Western Telegraph Superintendent, died at his residence in Toronto on the 6th of December. Mr. Toye was one of the oldest and best known telegraphers in America. More than forty years ago, in company with Messrs. H. P. Dwight, J. T. Townsend and R. Easson, he entered as a messenger boy the employ of the Montreal Telegraph Company., at Toronto, and continued his connection with the Company with which it afterwards amalgamated, during the long period mentioned. To him is given the credit of having been the first Canadian to practice the receiving of messages by sound. He was the inventor also of Toye's Automatic Repeater which found its way into use throughout Canada and the United States. Mr. Toye suffered a lingering illness due to pulmonary trouble, which eventually culminated in his death,

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Correspondence is invited upon all topics coming legitimately within the scope of this journal

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VOL. IV.

THE ELECTRICAL NEWS enters with the present number, upon its fourth year. Its development, though not rapid, has been steady and substantial, which, after all, is the kind which is most satisfactory. We extend our thanks to all who have in any way assisted us in the past, and in our continued striving towards improvement in the future, we hope to have the co-operation of every reader. We take advantage also of the present opportunity to extend to all our best wishes for a Happy and Prosperous New Year.

THE runaway car on St. Denis st., Montreal, will probably result in a great outcry for brakes, and more than likely some bright genius will want an electric brake, possibly after some design of his own. Evidently something better is required than the usual hand-brake for extraordinary grades, but of what use would an electric brake be when the trolley is off.

A SUIT was lately brought against the Bell Telephone Co. in Toronto by the proprietor of a livery stable, who claimed damages on the ground that his name and telephone number had been omitted by the defendants from one issue of their telephone book. In his evidence the plaintiff made the somewhat remarkable statement that the omission of his name and telephone number had resulted in a falling off of 50 per cent. in his business. In the light of such testimony as this, and of the enhanced appreciation of the value of the telephone by the company's subscribers since the efficiency of its system was impaired by the recent storm, the present would seem to be an opportune time to increase rates.

THE experiment tried on the Erie Canal, near Rochester, of towing by means of an electrically-propelled boat connected with a double trolley, is one which might be repeated with profit on several of our Canadian canals. Take for instance the Lachine Canal near Montreal; an extension from the Street Railway Company's trolley wire at 500 volts could readily be carried up there. Kingston again would probably give service at the mouth of the Rideau; the same would apply to Ottawa. This trolley wire could also be used together with "step down" motor dynamos to charge the storage batteries of electric skiffs, launches, &c. The great drawback to anyone putting such a boat on our present cruising waters is the trouble of getting the cells recharged.

PERHAPS no more startling proof of the rapid strides made by electricity can be found than taking a city directory of to-day and comparing it with one of a few years ago ; in the latter the term "Electrician" is not to be found, whereas to-day their name appears to be legion. This suggests the enquiry, "What is an Electrician?" On making an analysis of the aspirants who glibly dub themselves with this designation, we are of opinion that many of them are about as much entitled to do so as a man who ties up an injured finger is to style himself "M.D." Let those who would be electricians study and study hard, that they may so qualify themselves as to be known as such, not only nominally, but in reality.

Referring to our former remarks re varying candle powers on arc lamps, keeping the watts constant, as found by Prof. Cahart during his experiments, Crompton does not agree with him, but states that in his experiments he finds 42 volts give the best effect. He uses a larger carbon for the upper than for the lower, also has the upper one soft cored. Crompton states that probably Prof. Cahart's carbons were to blame. There is one thing certain, viz., that if anyone who uses an arc lamp on a constant potential circuit will try the effect of soft cored carbons in comparison with the usual hard variety he will simply be astonished at the result. This is especially the case in 52 volt alternating current arc lamps, which, with soft cored carbons, give a steady, pure white light.

WE publish elsewhere in this issue a report of a meeting of Ottawa Association No. 7, C. A. S. E., kindly sent to us by one of its members. This report is a model of what we would like to receive regularly from the Secretary or some member of every association. It indicates what subjects came up for discussion and what were the views which were expressed upon them, thus showing to the officers and members of other associations what matters are engaging the attention of engineers in Ottawa, and possibly suggesting to them subjects for discussion. There is also a hint given that the members of the Ottawa Association would be pleased to read the opinions of their fellow engineers in other places on the question which they have been considering. We have on one or two former ocassions pointed out that the columns of this journal might with advantage be used for the interchange of reports of the proceedings of the various associations, as well as the individual opinions of their members on points of interest to engineers.

IN the present issue is printed further correspondence on the subject of the relative values of high versus slow speed engines for electrical work. The preponderance of opinion expressed thus far seems to be in favor of the slow speed engine but no doubt the arguments on the opposite side are not all exhausted. The high speed engine is not without its friends. Only a few days ago we heard its praises being sounded by an engineer in charge of a street railway power plant, who, pointing with pride to the high speed engine by which the power was furnished, stated that it had been in constant operation 19 hours per day for nearly two years, and that during this period there had never been a break down, while the repair bill had not amounted to $5.00. This must certainly be considered a good record. It may be mentioned that on this road there are some heavy grades, thus imposing upon the engine great fluctuations of load. We shall be pleased to publish all further information obtainable on this interesting subject.

IT would seem that there is a great lack of information on the part of the public with regard to the amount of profit to be derived from the operation of electric lighting plants. It is only on this supposition that we are able to understand the action of business men in investing their money in lighting plant and entering into competition in small towns with those already in the business. In some of the towns in Eastern Ontario this competition has been carried to the extreme limit, especially as regards incandescent lighting, which in some localities is being furnished at or below cost of production. The citizens in these towns are congratulating themselves, as well they may, upon the existing condition of affairs, while the rate at which light is being supplied to them is being used as the means of forcing down prices in adjoining municipalities. The state of things is affecting so seriously the owners of electric machinery that meetings of those interested have lately been held to consider what steps should be taken to place the business on a more satisfactory and equitable basis. It is to be hoped that the statement of facts above set forth will suffice to deter others from entering into competition with existing lighting companies in localities where there is barely sufficient business to warrant the existence of a single plant.

The paper by Mr. G. C. Mooring on the value of different kinds of fuel for steam purposes, which we publish in the present number of the ELECTRICAL NEWS, opens up a subject of much interest both to engineers and owners of steam plants. Its importance, we believe, has not been as fully appreciated as it is desirable that it should be. While every effort has been made by engine makers to produce machines which can be operated with the greatest economy, and while high prices are being paid by steam users for machinery of this character, with the object of reducing the expense for power, it frequently is the case that firemen and engineers are employed who do not understand how to manage economically the plants entrusted to their care, and thus the advantages derived from the purchase of high class machinery, are offset by lack of skill on the part of firemen and engineers. "The best fireman I ever saw," said one of the ablest engineers in Canada to the writer recently, "was a man in charge of a battery of boilers who, instead of loading up his furnaces at long intervals with a coal shovel, went constantly from one furnace door to another and threw in upon the grate a small quantity of coal with a hand shovel. He seemed to know exactly where the fresh coal was needed, and had the ability to place it exactly on the right spot. By this method he secured the highest efficiency of which the boilers were capable with the least consumption of fuel." The fact is too little appreciated by steam users that it is economy to pay a man of this class a much higher salary than the one who does his work unthinkingly and at the expense of hundreds of dollars per year in wasted fuel.

A STRANGER, riding on a Montreal Street Railway car on one of the hill routes, would be apt to notice an individual standing beside the motor man, holding in his hands a massive weapon closely resembling a sledge hammer, the only difference being that the head is of wood. If he were of an enquiring turn of mind and ventured to ask the use of the aforesaid instrument he would be surprised to learn that it is the only safety appliance at present used by the street railway company in the leading city of Canada, in the event of the hand brakes refusing to work, as has occasionally happened. In emergencies where it has been called upon, the result has proven that as regards efficiency it is comparatively useless, the heavy car either pushing it aside or crushing it to matchwood. The effect on the nerves of the passengers sitting in a car over which the brakes have lost control, descending at an increasingly rapid rate, on suddenly coming into contact with this block of wood, may be more easily imagined than described ; and the effect on one of the unfortunates handling it was such that he was not likely to repeat the experiment. There seems no reason why the Westinghouse or similar air brake system as used by steam railways could not and should not be used as an emergency brake on electric cars. The only question would be that of expense, and considering the danger to cars, to say nothing of lives, this should not stand in the way of the improvement. To equip an electric car with such brakes it would be necessary for each station to be provided with an air compresser and each car to carry a cylinder of sufficient capacity. As they would only be used in case of emergency the expense of charging would be infinitesimal, and the first cost would really represent the whole outlay. If a trolley wheel could be had which would stay on the wire, or rather climb back on to it should it get off, a suitable electric brake might be found.

AS we go to press two very important matters are engaging the attention of the County Judge at Toronto. These relate to the attempt which is being made by the Assessment Commissioner of Toronto to fasten an assessment upon the personal property of the electric light and telephone companies, as well as upon the mains, retorts, etc., of the Consumer's Gas Co. In the case of the latter an assessment of half a million dollars is sought to be imposed. The gas and electric companies have carried the matter to the only source of appeal, the County Judge, before whom the question is being argued, and whose decision may be looked for very shortly. The Gas Company's property, is to be assessed not as personalty, as in the case of the electric companies, but as realty, on the ground that the mains, retorts, etc., are attached to the earth. As the decision in these cases will establish a precedent, and may effect very seriously the electric and gas interests of Canada, the outcome of the arguments now being presented will be looked for with unusual interest.

WE publish in the present issue a description and illustration of what is believed to be the oldest steam engine at present in operation in the United States. We would like to obtain a description of the oldest engine at work in this country. A comparison of the old engine which we publish with the latest improved types being manufactured in Canada affords an instructive lesson to those who feel an interest in the improvements which have taken place in steam engineering during the last half century. Will our readers, who may be expected to be interested in this subject, kindly send us any information which they may possess along the line indicated?

The stockholders and managers of electric companies may well hope that storms of the character of the one which caused such havoc to their property a week or two ago, may not be of frequent occurrence. It is to be hoped also that the public will now be able to realize that a fair margin of profit is necessary in lines of business which are thus subject to their property being suddenly and seriously damaged. Neither should the lesson be lost upon the managers of electric lighting companies, some of whom, as elsewhere stated, have been engaged in a ruinous competition. In Toronto and Montreal the inability of the street railway companies to grapple with a storm of this character was clearly demonstrated, but no doubt the experience gained will lead them to make preparations which will enable them to cope more successfully with such conditions in the future. In Toronto lack of sufficient power and a failure to make an early attempt to keep the wires free of ice, appear to have been the defeating causes. In storms of a less severe character the advantages of first-class construction have been manifest, but in this case the tremendous weight of ice upon the wires was sufficient to break down construction work of the best character, and the Great North-Western Telegraph Company's system, which suffered but slightly from the severe wind storms of last autumn, has been badly shattered in all parts of the country. The heavy loss which the various companies have sustained is not to be wondered at in view of the estimate which has been made that on a pole carrying one hundred wires the weight of ice during the recent storm would be about five tons.

NOTES FOR ENGINEERS.

It is sometimes necessary to test the truth of the fitting of an engine by lining it up and every engineer ought to know how to do it. In order that an engine shall run truly, it is necessary that the guides shall be exactly parallel with the cylinder, and that the crank pin shaft be exactly square to cylinder, and that the crank pin when revolving shall remain exactly in the plane of the centre line of the cylinder. By way of a simple example, take the case of an ordinary horizontal engine, in a mill, and consider how it may be proved that above conditions are complied with. First, have cylinder opened up, and piston and connecting rod removed. Fix securely a stick across back end of cylinder, and another in the gland for the piston rod. Find centre of cylinder and of gland, and stretch a cord through these centres and produce it, beyond crank shaft. If engine is right, this cord will be parallel to sides of cylinder and to guides, and will pass exactly in line with centre of crank shaft. Then turn crank over till crank pin touches the line on one side, and the cord should be in centre of width of crank pin and exactly square to it. Then turn crank over to the other side, and if shaft and crank are true, the pin will still be square to the line, and the line will be in middle of the length of pin. If all these conditions are complied with, then one may conclude that engine is fair and true. A large Corliss condensing engine of five feet stroke was found to be very hard on the packing used for the piston rod, and to require frequent tightening up to prevent the vacuum from being spoiled by air passing in at the sides of the rod. On lining it up, it was found that the guides were in the five feet, over ¼ of an inch out of parallel with the sides of the cylinder, and as the piston travelled back and forth the rod rose and fell over one eighth of an inch, or bent, and so destroyed the packing. The cylinder was re-bored, so as to make it parallel with the guide frame, and the trouble was cured

* * *

When a crank shaft is heating something must be done at once in order to carry off the extra heat produced and prevent the babbit from melting. Sometimes slackening the bearing a little to let oil run more freely through it is sufficient. Adding flowers of sulphur to the oil is sometimes successful, but in other cases it is necessary to get a stream of water to play on it. It is better to stop engine at first chance and examine bearing to find out the cause and remove it.

Some are puzzled to understand why a steam pump driven by steam at 60 lbs. pressure can force water into the boiler from which the steam is taken. If the steam cylinder were of the same diameter and stroke as the water cylinder, it would not be able to do it, but by making the steam cylinder larger in diameter or longer in the stroke, sufficient power may be got to overcome all the friction, and force the water into the boiler. If the steam cylinder be six inches in diameter and the steam 60 lbs. pressure, then the steam has a force of nearly 1700 pounds to move it. If the water cylinder be four inches diameter then the resistance to be overcome is 750 pounds, leaving about 900 pounds to overcome friction and to produce motion and give the water velocity.

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Readers of these Notes who are advanced in experience and knowledge, please remember the day when you did not know as much as you do now, and think of others who are younger, and who know now no more than you did long ago. Help the younger and less experienced to avoid the dangers and difficulties you had to fight your way through. Encourage the young fellows to tell out their difficulties and to ask questions. What a wonderful word "why" is when it has a big ? after it, and is followed by "because," spelt with a "B." What is a horse power? Why is the power of an engine measured by horse power? Because the first steam engines made for general sale were made to do work that had been done by horses, and the makers of the engine said that it would do as much work as ten horses, or twelve horses as the case might be. Later on some began to think the engine builders meant very small horses, when they sold an engine as of twelve horse power. James Watt went to London and got the biggest horses to be had, and tested what amount of work they could do, and concluded that 33000 pounds raised one foot high, in one minute of time, was a horse power. Then he made his engines to do that amount of work for each horse power he called them, and to do it without getting tired out as the horses did. In our day the term has not the sharp, definite meaning it ought to have even when applied to steam engines, and many are deceived thereby. To make matters worse, the same term "horse power" is applied to boilers. All the boiler can do is to produce steam, and an engine is needed to use that steam and produce power. Why, then, should horse power be applied to boilers? It originally meant, the size of boiler that should be used to make steam for an engine of that horse power. A horse power of boiler meant that the boiler could make into steam one cubic foot of water in an hour for each horse power it was called, that is, a ten horse power boiler was one that used ten cubic feet of water in an hour, or about 62½ gallons. This standard was fixed, because it was observed that the engine required about sixty pounds weight of steam in an hour for each horse power. As engines were improved, less steam was required, and now 30 lbs. of water per hour made into steam, is a boiler horse power. Some specify the temperature of the water, and the pressure of steam into which it is to be made, but all are not agreed on these points.

PIONEER ELECTRIC LIGHTING IN MONTREAL. *

By JOHN SMILLIE.

MR. CHAIRMAN AND GENTLEMEN :—The paper I have the honor of bringing before you to-night, is not of the class you have been accustomed to receive, judging by those I have listened to at your meetings and read in the printed reports in the CANADIAN ELECTRICAL NEWS.

Knowing as I do from the above sources of information the advanced knowledge this association has in all matters relating to electricity and magnetism, and that anything which tends to increase that store of knowledge is received with respectful attention, all due allowance will, I am sure, be made for the shortcomings of anyone who undertakes to bring any matter before this body in the form of a paper.

This, gentlemen, is an apology for carrying you back to the dark ages of electric lighting in this city, for when one considers the development of electricity, I think I am quite in order in speaking thus of the beginning of a period of 13 years in the history of electric arc and incandescent lighting in the city of Montreal.

In the year 1881 electric arc lighting was creating quite an agitation among those who were interested in the betterment of street lighting and the lighting of large halls for public assemblies all over the northern part of the continent of America. The city of Montreal was not behind the rest of the country in watching for the success of the new light, and no wonder, for it would have been hard to have found a city that was worse served with gas, than the city of Montreal at that time.

I cannot say whether the Brush arc machine placed in the Custom House to light up the wharves, or the crude attempts of the Craig people, who had one going at the Exhibition, and also on one or more of the Richelieu and Ontario Navigation Company's boats at that time, were the first to go into operation here, but the successful plant was the Brush, which went very well from the start.

The next plant to be put in was at the Quebec, Montreal and

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* Paper read before the Montreal Electric Club,

Occidental Railway Works at Hochelaga, and the St. Lawrence Hall, by the United States Electric Light Co., for a local company of which the late Mr. Senecal was president. The plants at Hocehlaga and at St. Lawrence Hall were being put up at the same time, but the one at Hochelaga was in advance of the one at the Hall, and was therefore finished first; and it was at that station the first public exhibition of electric incandescent lighting was made in Canada. I believe it was in July, 1881, when the formal starting of the incandescent plant took place, and it was made the occasion of a grand luncheon given at the Hochelaga works, at which no less a personage was present than his Grace the late Duke of Sutherland, who upon that occasion predicted a great future for incandescent lighting. Who would be bold enough to say that his prediction had not been fulfilled at the present time? and further, who would be rash enough to say we had reached the limit of improvement in incandescent lighting? none at least I am sure of those at this meeting.

I will now try to give you an idea of the machines we used at the St. Lawrence Hall. The incandescent machine was a 65 lighter, the arc machine a 5 lighter.

The arc machine was a five light Maxum supplied by the United States Electric Light Co. The armature was on the Gramme ring principle. There were 14 sections in the armature with four layers of No. 14 imperial gauge wire to each. The wire was double cotton covered. The core was made of sheet iron plates, one sixteenth of an inch thick. There were 114 of these pieces in the armature; they were placed together in pairs with spaces of one sixteenth of an inch between each pair; these plates had raised points at intervals for the layers of wire to lay in, forming 14 spaces in the armature.

The one sixteenth of an inch space, I need not say to you, was for the air to have free access to the coils to keep them cool, and I can assure you, it was all required, for after running five or six hours it would get so hot you could hardly lay your hand upon it.

The diameter of the armature was 8¾ inches; length 12 inches; the length of armature shaft between bearings was 16 inches, and the diameter one and one quarter inches. This was one of the troubles we suffered from; the spring of shaft was sometimes so great, that it would graze the field, thereby stripping the insulation off the armature wire, with a consequent short circuit.

The commutator had 60 strips in it, one of which I have now before you. There was a saw drift cut into it for about a ¼ of an inch, and the ends of the two wires soldered into it, thus to make the connection between the armature coil.

Those strips were fastened by two brass collars, one with a centre hollow piece for fitting on the shaft, and screwed on one end, two vulcanite bushes slipped on, and the commutator strips placed around resting on the pieces of vulcanite, with thin strips of leather board put between for insulation. When this was done I had a thin iron band with two knees rivetted thereto, and a bolt for drawing them tight together for turning the outsides; when this was done, the flanges were screwed together, and the commutator was turned and wires soldered in their places.

But I need not tell you that leather board made a very poor commutator insulation; short circuiting between the segments of the commutator was no uncommon event; sparking soon carbonized the leather board, and then my troubles began.

About this time Mr. Fred. Thomson came to Montreal to take charge of the Royal Electric Light Co., then in its infancy. One day I was telling him of my troubles with the commutator insulation, and he suggested asbestos paper. I tried it, but my troubles were not much lessened, for the fine particles of copper would get into the soft paper and in a short time make contact between the segments; then my work was to scratch out all the copper dust from the asbestos.

The line wire is about five and one-half imperial wire gauge. This was a naked wire; we stapled it to the woodwork and when we came into contact with gas, water or steam pipes, we would put a piece of rubber tube over the wire at those points.

When we wired this machine first, we grounded the return wire upon the main gas pipe, but it ran very unsatisfactorily, and later we returned to the machine.

The lamps were very good, and indeed the lamps in use in the city to-day are not much in advance of those we used then, except in mechanical detail and insulation. The body of our lamps was not insulated; the clutch for lifting the carbon rod was worked on the same principle as at present with fine wound magnets for regulating the lift of carbon, and I must say the candle power of them was very much in excess of the lamps now in use in this city, although they were designated 2000 candle power, as the ones in use are at present.

The carbons used were the Wallace diamond carbon; the cost of them was about ten cents each.

The bearings of this machine were at times very hard to keep cool; sometimes we had to keep ice on the journals for two and three hours at a time. As to measuring current, we had no means of doing so: if a machine gave current enough for a given number of lamps without burning or overheating that was enough for us, and the only means we had of ascertaining its load; the number of revolutions this machine turned per minute was 1200.

The incandescent machine, as I have already stated, was a 65 light machine, also a Maxum type. This machine had a commutator on each side of the armature. Each commutator had 60 segments, and they were insulated with leather-board. The iron core of the armature was made in same manner as arc machines, with this difference that there were 30 sections, and in each section there were two coils connected with four segments of commutator, and each alternate coil was connected to opposite commutator.

The length of armature was 18 inches; diameter 13½ inches. The wire used in armature was No. 10 imperial gauge, with four layers of wire in each coil. Field coils were 18 inches long by 7½ inches high, with eight layers of wire on each, of No. 5½ imperial gauge.

The length of shaft inside bearing to inside bearing was 30 inches; diameter of shaft 1⅝ inches: the bearings were of the sleeve form, and were adjusted with set screws from sides, much as an adjustable hanger for shafting.

The diameter of line wire was No. 1½ imperial wire gauge, and the branch wires to lamps were 16½ imperial wire gauge, run on the multiple principle: we had the lamps screwed upon the gas fixtures, and used the gas pipes for our return wire.

You will see by the lamp and switch before you, the method we adopted for connection; it was no uncommon thing for a wire to short circuit by making contact with the gas lamp, and in a moment we had the covering on fire for as much as 30 feet at times. This wire was double covered cotton, dipped in paraffine, and when it caught fire it made quite a blaze and smell. Indeed it required the closest watching, and even then we had two or three insipid fires which vigilance alone prevented from being of a dangerous character.

One of those fires, I will describe, which will be enough to show to you what troubles were in store for the unfortunate who had to look after an electric plant in those early days of electric lighting. In the refreshment room of the St. Lawrence Hall hotel we fitted up an old lamp; its form was a stem with three rings, one very large and the other two below, each about 12 inches smaller than the one above; on those rings we hung about 25 lamps, and the wire came through the ceiling and down the stem, and branches were taken to lamps of the small size wire, the return wires being clustered and carried up between the floors, then a large size wire carried down to main gas pipe and grounded. One of those small return wires made contact with positive wire and short circuited, and when it got very hot, it bent down, unable when hot to support its own weight; unfortunately lying directly under it was a ¾ inch composition lead pipe (gas); the heat very soon melted it, and you know what would follow. I was in the refreshment room at the time, and the lights gave a bad flicker. The room above had been left with carpet loose, also part of flooring, so that we might easily get at the wire. When the room was reached and flooring lifted there was a ¾ inch gas pipe burning and lead melting, and the wire at almost a white heat. It was quite a long distance to where the engine was; the gas main was in another building, and the joists and flooring on fire. Gentlemen, it was one of those dilemmas that a man does not want to be placed in very often in his lifetime. I had the gas shut off as quickly as possible, then the belt off the incandescent machine, then fire in the woodwork put out. The damage done amounted to very little, but it would have been bad enough had we not caught it in time.

As a matter of fact all our pipes were charged more or less with electricity. The drinking fountain in the office at times was so charged that when you took hold of the pull to draw water, you would get such a shock that you felt disinclined to try it any more. The surprise to me to-day is, that we did not succeed in burning down the hotel.

We had this plant going for two years, and the incandescent machine is in good working order yet. I had no trouble with this machine; it ran smoothly and had no repairs done to it whatever; it had a separate machine for exciting its magnets. The workmanship on this machine was first-class. The mechanism for increasing or diminishing the current was of a complex character; this I will not attempt to explain at this time.

At the junior conservative ball held in St. Lawrence Hall in 1882, at which Lady Macdonald was Lady Patroness, we had placed upon the banquet tables a number of fish bowls, some with different coloured waters in them, and others with clear water, and gold and silver fish therein. We had incandescent lamps placed in them, and when the guests sat down to the tables, we switched in the current, and I can assure you it had a very beautiful effect. We had to keep ice constantly in the water to keep it from over-heating. I mention this circumstance because it was considered quite novel at that time.

The engine we used was an old slide valve, with cut-off valve; it was 11 inches by 22 inches; we carried 60 lbs. steam pressure. We allowed four incandescent lamps per h. p., this gave us 14¼ h. p. for incandescent machine, and about 6¼ h. p. for arc machine, or 20½ h. p., not speaking of friction of engine or shafting. Our average run per day was 5 hours and the consumption was 925 lbs. of Scotch coal, or in other words 8·6 lbs. per hour per h. p.

This, gentlemen was what we did in the year 1881.

The Dodge Wood Split Pulley Company, of Toronto, recently shipped a split pulley 14 feet in diameter and having a circumference of 42 feet. This is believed to be the largest split pulley yet manufactured in Canada.

A FEW POINTS ON THE CALORIFIC VALUE OF FUEL.*

By G. C. Mooring.

Mr. President, Brethren and Friends: When the Educational Committee was appointed, each one promised to do his best to get up a paper; this is my excuse for standing before you to-night. The figures I may quote are from books and mechanical papers in my possession, and I shall endeavor to give the proper authorities due credit. I will, however, leave out most of the university terms, for the very good reason that I do not understand one-half of them myself.

Economy in fuel is of vital importance to our employers here in Toronto, the price being high and competition in manufactured goods very close. It is calculated that there are four hundred million tons of coal burned every year, and more than half of this is used to generate steam for power purposes. There is imported into Toronto five hundred thousand tons, including all grades, and thousands of cords of wood, besides all the refuse from our planing mills. Fully one-half of this is used to generate steam. Now, if we as working engineers can combine a little theory with our daily practice and thereby save a little of this vast coal pile, I consider it no more than our duty to do so; and this can best be done by talking over and discussing the matter here in our association meetings, for there is none of us that knows it all.

To determine the quantity of heat that may be obtained from various combustibles is an important branch of Applied Chemistry. Before heat can be measured, however, it is essential to establish some unit standard of measurement. The British thermal unit commonly used in England and this country is that quantity of heat necessary to raise the temperature of one pound of water from sixty to sixty-one degrees Fahrenheit. Each British thermal unit, or, as we will call it, heat unit, has the mechanical energy equal to raising one pound seven hundred and seventy-two feet. Water was selected as the standard for thermal comparisons because it can be readily and easily obtained in a state of purity, and because its capacity for absorbing heat is greater than that of any other known substance. This capacity to absorb heat as its temperature rises is technically called specific heat, consequently the specific heat of other bodies can readily be obtained with water as a standard.

CALORIFIC POWER.

The amount of heat to be obtained by the combustion of a definite weight of any fuel is called calorific power. The earliest and perhaps most extensive researches to determine the calorific power of combustibles were undertaken by Favre and Silberman. Their method of operation consisted in burning a very carefully weighed quantity of the substance in question enclosed in a small metallic vessel which could be immersed in a receptacle containing a weighed quantity of water, which was protected against radiation by a jacket of non-conducting material. The inner vessel containing the substance under test was provided with an inlet tube for supplying a sufficient amount of pure oxygen, and an outlet pipe coiled back and forth through the water, which formed an outlet for the products of combustion. By thus burning in the inner chamber a weighed quantity of fuel and ascertaining by means of a thermometer the rise of temperature of the water, the calorific power of the substance was immediately determined. The instrument thus used to determine calorific power is denominated a calorimeter. Other forms of calorimeters have been invented, but nearly all agree on the calorific power assigned to carbon, hydrogen and such of their compounds as form the great bulk of combustibles. When the gas hydrogen is burnt in pure oxygen the same authorities found by direct experiment that sixty-two thousand five hundred heat units were evolved for every pound of hydrogen consumed. They also found that for every pound of carbon consumed fourteen thousand five hundred heat units were obtained. The calorific power of a fuel or the quantity of heat developed during the burning of a definite amount of any combustible is always the same, and is entirely independent of the rate at which combustion takes place. Every pound of carbon consumed with the proper amount of air yields fourteen thousand five hundred heat units. Whether combustion occurs as in the discharge of a gun, or whether it occupies years, as in the decay of a tree trunk, signifies little in the total amount manifested.

Now, according to the thirteenth edition of Reed's Engineers' Hand-Book—a book of very reliable and practical information for engineers, and which is authorized by the British Board of Trade—we find that in practice every pound of coal we burn requires three hundred cubic feet of air, or one pound of carbon requires twelve pounds of air; and to one pound of hydrogen we require thirty-six pounds of air. Now, we have already seen that hydrogen is about four and a quarter times the value of carbon, but we have very much more carbon in the fuel than hydrogen.

After looking into the method of testing fuel and finding the principal components for giving heat to be carbon and hydrogen when properly mixed with the oxygen of the atmosphere, we will now look into the calorific value of the different fuels. Commercial fuels may be classed as natural and artificial. Natural fuels are wood, coal, mineral oil and natural gas. Artificial fuels are obtained from natural fuels by certain processes of manufacture; for example, from wood we get charcoal, and from coal coke is manufactured.

Dr. Percy classes the natural fuels as follows: Wood, peat, lignite, bituminous or soft coal, anthracite or hard coal, petroleum oil and natural gas; but no doubt the first fuel used by man was dried sticks gathered in the wilderness, kindled by rubbing two sticks together in the old Indian style, and to this day I believe wood is the most widely used fuel, owing to its almost universal distribution. Taking the average wood when fresh cut, it contains about fifty per cent. of moisture, but when thoroughly air dried this falls to about twenty per cent. According to C. Williams Siemens, D.C.L., the average calorific value of wood as far as its heating quality goes, is: carbon, fifty per cent.; hydrogen, six per cent.; oxygen, forty per cent.

Next comes peat, which is found in swampy, or what may have been swampy places; the largest bed I have read of in America is near South Bend, Indiana, which is three miles wide, sixty miles long, and from five to fifty feet deep. I have also heard that there are large beds in our own country. Peat is not much used in this country, but in Ireland, Germany and Sweden it is used extensively. Peat is totally unfit for use as a fuel until dried; according to Sir Robert Kane the average calorific value of Irish peat is: carbon, fifty per cent.; hydrogen, six per cent.; oxygen, thirty-one per cent.

By far the most important fuel is coal. The first variety is lignite, which is generally brown in color; sometimes looks very much like true coal, but is not worth as much as the poorest kind of coal. In America it is only used in the localities where it is found, namely: Kentucky, Colorado, and west of the Mississippi river. Its calorific value according to Arthur V. Abbott, C.E., is: carbon, forty per cent.; volatile combustible matter, twenty-three per cent.

Next comes bituminous or soft coal, which is used most in this city for steam purposes. There are many kinds of soft coal imported into Toronto, but for my part I much prefer the Renellsville Soldier Run; I believe that almost as much steam can be generated from a ton of this coal as from a ton of the best hard coal. There is coking and con-coking soft coal. From the coking coal a great deal of coke is made in the mining regions and is used extensively, being light to transport. This coal is also valuable for gas manufacture. Did you ever make gas in a small way? Get a long clay pipe, fill the bowl with powdered soft coal, cover over with blue clay, place it in the fire with the stem projecting out, and in a few minutes the gas will come out of the stem; then light and it will burn for some time. I have always understood that illuminating gas was invented in this way.

The difficulty with soft coal is that it is dirty to handle and blocks up the tubes of a boiler with soot and emits a black smoke. There are over three hundred patent smoke consumers, so called, some of which may assist to burn the smoke, but I have yet to see a perfect one, and even in Chicago, where a smoke by-law is in force, one cannot see beyond a few blocks from the roof of any high building for the dense smoke, soft coal being used for steam purposes. I believe that most of our grate bars are set too close to the boilers for burning soft coal, there not being room enough for combustion. I think this is one of the reasons why a water tube boiler gives better duty than the tubular boiler, there being more room for the mechanical combinations of the different gases of the coal with the oxygen of the atmosphere. Then again, the tubes must be hotter than the shell of a boiler on account of the very rapid circulation which must be going on in a water tube boiler, for it is a well known fact that the hotter the surfaces with which the gases come into contact, the better the combustion. But these water tube boilers do not evaporate as much water per pound of coal as is sometimes claimed. One of the professors of the Engineering Department of McGill University, Montreal, told us this summer that nine to one was the best they could ever reach under test. The calorific value of soft coal averages eighty per cent. carbon and five per cent. hydrogen.

Anthracite or hard coal is the oldest of the coal family, and is generally the lowest of the coal strata. It is very hard, which makes it the best of all coals for transportation. It is hard to ignite, but when kindled burns with a high temperature and steady glow, emitting no flame or smoke and does not coke. In density hard coal is superior to all other fuels. It is used in all our government buildings—Dominion, Local and Municipal—and even in our water works pumping stations, I suppose for the reason that it is cleaner to handle and that there is considerably less work attached to it; certainly not because it is the cheapest. With the present prices of coal at least twenty per cent. could be saved at our main pumping station by using a good soft coal instead of hard. The average composition of Pennsylvania hard coal according to the same author, C. William Siemens, D.C.L., is: carbon, ninety per cent.; volatile matter, five per cent.

Probably no discovery of the present century has brought a more widely extended change in manufacturing operations than that of natural gas. Already in Pittsburgh there are thousands of miles of pipe lines, and it is fast taking the place of coal in the favored localities. Natural gas is found in many places in Canada, and has been put to practical use in the county of Welland and at the new asylum near Toronto, but the quantity appears to be limited; it is also found that manufactured gas can be used to advantage for steam purposes, but not in Toronto, chiefly owing to the high cost of coal.

The only natural liquid fuel is crude petroleum, which is found in the United States, Russia and Canada. Since its discovery many attempts have been made to use it for power purposes, but it is only of late years that the attempts have proved successful. One great point in its favor is that it has nineteen to twenty-one thousand heat units, against thirteen to fourteen thousand for coal, and it only requires the price to come down a little when it would become a dangerous competitor of coal. While our President, Bro. Wilson Phillips, and I were in Chicago visiting the Fair, we had an opportunity of seeing oil used in a practical way for power purposes, as the main battery of boilers in the World's Fair buildings, consisting of twenty-seven thousand h. p., all water tube boilers and of many different makes, were all fired with oil fuel. We also visited three of the main cable road power stations; they also used oil fuel. At the North Clark

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* Paper read before Toronto Association No. 1, C.A.S.E.

Street Station the chief engineer, Mr. O'Connor, who is an old Toronto boy, told us that oil fuel was not much, if any, cheaper than coal, and certainly not as cheap with a small power plant, but it is by a long way the cleanest—the boilers and everything about them being easily kept clean and in good order.

Perhaps a word or two on the latest method of burning oil to generate steam would not be out of place. There are two forms of very similar apparatus, one using compressed air, the other steam. The object seems to be to spray or atomize the oil as finely as possible. The apparatus for oil firing is first a large tank or reservoir at a safe distance, either sunk into the ground or bricked around to protect it as far as possible from fire. In the case of the steam system, the oil is conducted to a smaller tank, near the furnace. The oil from the main tank is allowed to flow by gravity, but at the Fair it was pumped by large duplex pumps. From this smaller tank, which is only supposed to hold enough oil for a few hours' run, the oil flows to the burner, which is practically a steam siphon. The oil jets are within the large pipe containing the air, so that by the force of the steam and air the oil enters the furnace in a very fine spray. The oil, air and steam can be separately regulated, and when properly adjusted almost perfect combustion is obtained. It makes a roaring noise, and on looking into the furnace nothing but a mass of white flame can be seen. The ash pit doors and all other inlets are closed, and no smoke comes from the stack. The only drawback about this system is that an auxiliary boiler is necessary, or steam must be raised with other fuel, as it cannot be started without steam. Crude oil contains 84 per cent. carbon and fourteen per cent. hydrogen.

From an average of thirteen experiments with good soft coal, Dr. Brunt found out of a possible fourteen thousand four hundred and thirteen heat units, only eight thousand four hundred and thirteen were inducted into the water in the boiler—so it is quite likely that we very seldom get more than one-half of the heat of our fuel; and the engine is still more wasteful, as never more than twenty-five per cent., and not very often more than ten per cent., of the heat units are taken out of the steam; but in this country for about seven months of the year we make good use of this waste steam by warming our buildings with it. Look from the top of any of our buildings on a cold morning and you will not see very much exhaust steam going to waste—with one exception, and that is, the Terauley Street Electric Light and Power Station; there clouds of steam from a very large exhaust pipe may be seen any time. Now, I am satisfied that had this station been situated among some of our large buildings, every pound of that steam could have been sold for heating purposes, for at least seven months of the year, and the revenue from this source would have paid at least half the coal bill. One electrical manager said in convention—I think it was in Philadelphia—that the revenue from the sale of their exhaust steam almost paid their coal bill during the winter months, and they never carried more than three pounds back pressure on their engines.

There is a fortune awaiting the man who can give us power straight from the fuel. I lately read of a man in Germany who is working with this object in view. He grinds the coal to a very fine powder and explodes it in the end of the cylinder, after the style of the gas engine, but he could not get rid of the ashes and soot. I think there is a great field for inventors along the line of the internal combustion engine. An efficiency of twenty per cent. has been realized, with bright prospects of doing better.

Just a word now on patent fuel. The earliest patent we have mention of was granted by the British patent office in April, 1773, and there have been hundreds of patents granted since then; nearly all of them have been directed towards utilizing the mine waste, which is calculated to be fifty million tons per annum for the whole world. This field for inventors still exists. Surely some way can be found to save this annual waste of energy!

The sawdust of our saw mills used to be a burden to the owners, and I have known them to move the mill rather than the piles of sawdust around it, but all that has changed now; their power is generated with the sawdust automatically fed to the furnaces, and they now sell the slabs which they used to burn. Have you seen anything of the patent coal compound agent? I think him a pretty good agent who will go to any intelligent engineer and try to make him believe that he can save twenty-five per cent. by mixing a few pounds of rock salt, or whatever it is, with the coal. There are seven million heat units in five hundred pounds of coal—I am sure there is not in five pounds of compound—neither can we get any more out of the coal than there is in it, and to wet the coal the very best authorities agree is detrimental.

Then as working engineers it is our duty to keep our boilers clean both inside and out, watch our fires closely and keep the grate and bars covered, for I believe with the coal we get, which is coking, the danger is in admitting too much air instead of not enough. We should make the best use of the appliances given in our charge, whatever they may be.

Toronto is situated so that we might save a large amount of our coal bill by utilizing the vast water power which nature has placed at our service. Thirty-eight miles north of us we have Lake Simcoe, three hundred square miles in extent, with a head of four hundred and seventy feet, and with a thousand square miles of water shed. If that would not be enough, we have Georgian Bay, an arm of the great lakes, with three hundred and fifty feet head, and if we were to draw five hundred million gallons per day the people of Niagara Falls would never miss it.

Messrs. O. Kartzmark & Bro., of Hamilton, have assumed control of the business of the late Mr. Geiss, and will engage in all kinds of mechanical and electrical work.

DESCRIPTION OF THE KINGSTON LIGHT, HEAT AND POWER COMPANY'S PLANT.

(By a Correspondent.)

A short time ago I had the pleasure of looking over the plant of the Kingston Light, Heat and Power Co., a description of which I have much pleasure in forwarding to you for publication.

The officials of the company are as follows: Mr. B. W. Folger, Superintendent; Mr. J. Campbell, Electrician; Mr. Robt. King, Chief Engineer; Messrs. S. Donnelly and J. Gallavin, Assistant Engineers. The station itself is a substantial stone building on Queen street, near the water front. The plant consists of three horizontal cylinder tubular boilers, 66″ × 14′ × ⅜″ steel plate, built to carry 125 pounds pressure pr. square inch. These boilers are fed by a Northey Improved Compound Plunger Pump, 6″x11″x10′x5, the cylinders of which are nicely lagged, making it a very handsome pump. There are two tandem Compound Corliss Engines, built by Messrs. J. Inglis & Sons, of the following dimensions: 16″ and 30″ × 42″.

These engines run at 85 revolutions per minute and have fly wheels 16′ diameter and 36″ face. The engines run "under" and belt back from fly wheel to a counter shaft, which is fitted with Waterous Patent Grip Pulleys.

The engines are condensing; a Northey independent condenser and air pump being in use. These engines are a credit to the builders, Messrs. J. Inglis & Sons and also to the Chief Engineer, Mr. Robert King, who erected them. They are substantially built and the finish and workmanship leave nothing for the most fastidious engineer in the country to desire.

The electrical part of the plant consists of two No. 20 1000 light 16 c. p. 220 volt Edison Generators on the 3 wire system used for incandescent lighting; one T. & H. 35 light 2000 volt arc dynamos; two Wood 50 light 2000 volt arc dynamos; one T. & H. 1,500 light 2,080 volt alternator, with an Edison exciter for long distance lighting; one T. & H. power generator for street railway work.

The above machines were wired to one of the finest switchboards in Canada, which is elaborately fitted with all the necessary recording instruments to be found in any first-class station. I was shown some indicator cards taken from the engines which proved beyond a doubt that they were running economically. I was also informed that during a test made a few weeks ago, these engines developed a h. p. per 2⅛ lbs. of hard and soft screenings, with a proportion of 3 of hard to 1 of soft.

A distinguishing feature about this plant is its cleanliness. There is apparently a place for everything and everything is kept in its place. Taking it all in all, it is one of the best kept plants which it has been my fortune to visit, and is a credit to Chief Engineer King and his assistants. If any engineer should be visiting Kingston, I would advise him to call in and see this plant, and he will receive a hearty welcome from those in charge, and will see something to interest him.

THREE TERRIBLE BOILER EXPLOSIONS.

On the 2nd of November there appeared in the daily papers accounts of three boiler explosions, attended by great loss of life and property.

The most serious of these took place in the stables of the Dry Dock, East Broadway and Battery Surface Railroad Company, at Fourteenth street and Avenue E, New York City, and tore out the building, causing death and destruction. The section of the building in which the boiler was located collapsed. The boiler flew across the street and struck the double tenement No. 534 East Fourteenth street, just below the first story. The side of the building was crushed in. Three men were instantly killed and nearly a score were injured, several of whom have since died.

The second explosion took place on the steamer City of Alexandria, while on her way from Matanzas for Havana and New York. As a result the vessel took fire and was destroyed, and a number of persons on board were drowned.

The third explosion took place in a flour mill at Windfall, Ind., and occasioned the death of the fireman and the serious injury of some other persons.

In the light of such terrible occurrences as these, the action of the Quebec Legislature in incorporating into the new Factory Act of that province a clause making compulsory the proper inspection of boilers in manufactories, is well-timed.

ELECTRIC RAILWAY DEPARTMENT.

LONDON STREET RAILWAY CO. VS. CORPORATION OF CITY OF LONDON, ONT.

In July, 1892 the London Street Railway Company commenced to build their tracks on Dundas street west, in accordance with the provisions of their agreement with the City, when the City applied for an injunction to restrain them from building the said tracks on the grounds that the Company forfeited its rights to the use of the street by not constructing the railway sooner.

The case was tried at London on Oct. 7th, 1892, before Hon. Mr. Justice Rose, who gave judgment as follows.;

"I find that there is no time limit by implication, that there is no express limit fixed by the by-law; that there was a right given to the London Street Railway Co. with respect to the streets named; that the Company had the right to exercise its franchise with reference to those streets subject to the provisions of clause 33 giving the ten days notice; that the laying of a proposition before the City Council did not suspend the right that had been granted to the Street Railway Company, by clause 2 of its by-law, giving it the exclusive right, and that as long as the Street Railway Company was proceeding in accordance with the provisions of the agreement to occupy the streets, it had the right to do so unobstructed by the City or its officials, until by operation of the provision of Sec. 21 that right was suspended.

(Section 21 of the by-law provides that when other persons propose to construct a railway in the City of London, the London Street Railway Company shall be given the option to construct the railway, and in the case of a refusal, the City to have the right to give the privilege to the said persons.)

The judgment was given so late in the season that the construction of the portion of track in question was delayed until 1893, when in July the Company again commenced to build their track on Dundas street west, and the City ordered the Company to stop the work, and take up the rails that had been laid (about 120 ft. of street.) This the Company refused to do, whereupon the City ordered their workmen to tear up the tracks under police protection, on the ground that it was a double track, when the agreement only provides for a single track with the necessary switches and turn outs. The Company then entered an action against the city for damages, and the case was heard before Hon. Mr. Justice Falconbridge early in October, 1893, who delivered judgment as follows;

"The contention of defendants that the bylaw and agreement are ultra vires, as set forth in the first paragragh of the statement of defense, is res judicata, having been disposed of by the judgment of Mr. Justice Rose in the suit of the present defendants against the plaintiffs, in the chancery division. And no new facts were shown bearing on Paragraph 5, which sets up that the plaintiffs have no right now to construct tracks on Dundas street, west of Richmond street, and that issue is also res judicata by the same judgment.

"The experts all agree that it is not possible to tell on the ground whether the two uncompleted tracks were, or were intended to be, part of a double track or of a switch, and the defendants had therefore no right to assume that work which had not in fact actually become a nuisance would do so. (Garrett on "Nuisances," page 315.) Easton, etc., Passenger Railway Company vs. City of Easton, Pa. St. 505, is strong authority in plaintiffs' favor.

"True, the plaintiffs were assuming to work on defendants' property—an element of distinction from some cases on this subject—but plaintiffs were not there as trespassers, but of right, as Mr. Justice Rose has found, provided they are in other respects within the bylaw and agreement.

"The argument that 'single track' in section 2 of the bylaw means just a single line of rails, and that the company cannot even have a switch on Dundas street, west of Richmond, is too refined and subtle for me, and I cannot give effect to it.

"Nor do I think section 6 (which deals with what in street railway parlance is known as 'the devil's strip') can apply to switches where the rails must converge at both ends.

"And I read the whole of section four together, and hold that the supervision and satisfaction of the city engineer have relation to the 'substantial manner and according to the best modern practice,' as to which there is no real complaint, but the complaint is founded on a supposed construction of the bylaw and agreement. Section 22 provided that the railway shall not be opened until he shall have given his certificate in writing that the road is in good condition and has been constructed in all respects conformably to the provisions of the bylaw. That is another matter.

"There will be judgment for plaintiffs as prayed with an injunction and a reference as to damages, in which reference the master is to have regard to the agreement of Aug. 2, 1893, filed before meant the argument.

"Cost to plaintiffs to issuing of this judgment. Further directions and costs reserved until after report.

[As we go to press it is learned that the above decision has been reversed by Chief Justices Armour and Street in the High Court at Toronto]

THE DUTY ON STEEL RAILS FOR ELECTRIC RAILROADS.

Under a ruling of the Customs Department at Ottawa, steel rails for use on steam railroads may be imported into Canada duty free, while on steel rails for use on electric railroads, a duty of $6.00 per ton is imposed. A deputation of gentlemen interested in electric railroads in various parts of the country, waited upon the Premier and members of the Dominion Cabinet a few days ago, and urged that the ruling of the Department be changed and the import duty on rails for electric roads removed. Sir John Thompson in reply to the deputation stated, that while personally he was of the opinion that the Act provided for the imposition of the duty, he was free to admit that the clause in the tariff was open to two constructions, and this being the case, the Government would leave the question to be decided by the courts. We have some recollection of a decision having been given against the Government on this point in one of the inferior courts some months ago. There is reason therefore for the hope that the ultimate decision will be favorable to doing away with the present anomalous interpretation of the tariff by the Customs Department. *The Canadian Manufacturer* urges the Government, instead of removing the duty from rails for street railroads, to impose it upon rails of all kinds, with the object of developing the manufacture of steel rails in Canada. Our contemporary, in pointing to the advantages which would accrue to the country from a steel rail manufactory, overlooks entirely the fact that in order to build up one such manufactory, a burden must be imposed upon electric railroad development and indirectly upon manufacturers of electric railway appliances. We contend that the growth of electric railroads will do more for the development of Canada than a manufactory of steel rails, and the government in dealing with the matter, should legislate in the interests of the many rather than the few.

The City Council of London Ont., have finally decided not to submit the question of changing the street railway system from horses to electricity to the electors at the coming elections as was talked of some time ago.

The American Street Railway Association has under consideration an invitation extended by the Canadian delegates to the recent convention at Millwaukee, Wis., to hold its convention in 1895 in the City of Montreal.

The City Engineer of Halifax has recommended the Council to accept the plans and specifications submitted by the Halifax Street Railway and Motor Co. for operating by the trolley system the street railway of that city. A charter empowering the company to use electricity was granted by the Legislature two years ago, but owing to internal dissensions in the management of the company, the change was not carried out,

THE PHILOSPHY, APPLICATION, CONSTRUCTION AND IMPROVEMENT OF THE STEAM ENGINE. *

By J. C. Gough.

I have much pleasure to-night in reading to you the first of a series of papers on the philosophy, application, construction and improvement of the steam engine, which, arranged in my simple way, may be of some moment to you in the pursuit of your daily avocation as electrical engineers. It is a question that interests us all, and one that cannot be too often repeated and studied with interest.

The philosophy of the steam engine presents an interesting study, as well as that of the successive changes in its mechanism. In the operation of the steam engine, we find many of the important principles which constitute the physical sciences. The steam engine is an ingenious, but not yet a perfect machine for transforming the heat-energy obtained by the chemical combination of a combustible with the suppoter of combustion into mechanical energy. But the original source of allth is energy is found far back of its first appearance in the steam engine. It had its origin at the beginning, when all nature came into existence. After the solar system had been formed from the vapory chaos of creation, the glowing mass which is now called the sun was the depository of a vast store of heat energy, which was thence radiated into space with unmeasured intensity.

The heat energy received from the sun, during the past life of the globe, uoon the earth's surface, was partly expended in the production of great forests, and the storage, in the trunks, branches and leaves of the trees of which they were composed, of an immense quantity of carbon, which must have previously existed in the atmosphere, combined with oxygen, as carbonic acid. The great geological changes which buried these forests under superincumbent strata of rock and earth resulted in the formation of coal-beds, and the storage during many succeeding ages, of a vast amount of carbon, of which the affinity for oxygen remained unsatisfied until finally uncovered by the hand of man. Thus we owe to the heat and light of the sun, the incalculable store of potential energy upon which we depend so much for life and all its necessaries and comforts.

This coal thrown upon the grate in a steam boiler, takes fire, and, uniting again with the oxygen, sets free the heat in precisely the same quantity that it was received from the sun and appropriated during the growth of the tree. The *actual* energy thus rendered available is transferred, by conduction and radiation, to the water in the steam boiler, is converted into steam, and its mechanical effect is seen in the expansion of the liquid into vapor against the superincumbent pressure. Transferred from the boiler to the engine, the steam is there permitted to expand in doing work, and the heat energy with which it is charged becomes partly converted into mechanical energy, and is applied to useful work in the electrical power house or in driving locomotives or steamboats. Thus we may trace the store of energy received from the sun until it is finially set at work (thanks to science for the light thrown on this dark subject).

The transformation which takes place in the furnace is a chemical change; and we might still go further and observe how, in each case, it is again usually retransformed and again set free as heat energy; the transfer of heat to the water and the subsequent phenomena accompanying its passage through the engine, are physical changes, some of which require very minute mathematical operations. Therefore we will be content with revieiving the different points of interest attached to the phenomena of physical science as we encounter them from time to time in these papers, in a simple and practical sense.

As has been already stated, the steam engine is a machine which is especially designed to transform energy, originally dormant or potential, into active and usefully available kinetic energy. When, millions of years ago, in that early period referred to in this paper and which geologists call the carboniferous, the kinetic energy of the sun's rays, and of the glowing interior of the earth, was expended in the decomposition of the vast volumes of carbonic acid, with which air was then charged, and in the production of immense forests which then covered the earth with their almost inconceivably luxuriant vegetation, there.was stored up for our benefit, then uncreated, an inconceivably great treasure of potential energy, which we are now utilizing to an extent. This potential energy becomes kinetic and available wherever and whenever the powerful chemical affinity of oxygen for carbon is permitted to come into play and the fossil fuel stored in our coal-beds or the wood of the existing forests is, by the familiar process of combustion, permitted to return to the state of combination with oxygen in which it existed in the early geological periods.

The philosophy of the steam engine, therefore, traces the changes which occur from this first step, by which in the furnace of a steam boiler, this potential energy, which exists in the tendency of carbon and oxygen to combine to form carbonic acid is taken advantage of, and the utilizable kinetic energy of heat is produced in equivalent amount to the final application of mechanical energy to machinery of transmission, through which it is usefully applied to driving machinery of all kinds.

The kinetic heat energy developed in the furnace of the steam boiler is partly transmitted through the plates which enclose the steam and water within the boiler, there to evaporate water, and to assume that form of energy which exists in steam confined under pressure, and is partly carried away into the atmosphere in the discharged gaseous products of combustion, serving, however, a useful purpose on its way, by producing the draught needed to keep up combustion.

The steam with its store of heat energy passes through winding pipes and passages to the steam cylinder of the engine, losing more or less heat on the way, and there expands, drving the piston before it and losing heat by the transformation of that energy while doing mechanical work of equivalent amount. But this steam cylinder is made of metal, a material which is one of the best conductors of heat, and therefore one of the very worst possible substances with which to enclose anything so subtle and difficult of control as the heat pervading a condensible vapor like steam. The process of condensation and reevaporation, which is the great enemy of economical working, thus has full play, and is only partly checked by the heat from the steam jacket, if there be any, which, penetrating the cylinder, assists in keeping up the temperature of the internal surface and checking the first step, condensation, which is an essential preliminary to the final waste by reevaporation. The piston is also of metal, affording a most excellent exit for the heat escaping to the exhaust side.

Finally, all unutilized heat rejected from the steam cylinder is carried away from the machine, either by the water of condensation, or in the non-condensing engine, by the atmosphere into which it is discharged. Reviewing the operations which go on in this machine during the process of transformation of energy which has been outlined, and studying it more in detail, we may deduce the principles which given its design and construction, guide us in its management and determine its efficiency.

My next paper will be more in detail, coupled with calculations by way of illustration, etc.

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* Paper read before the Montreal Electric Club.

... THE ...

Canadian General Electric Company

LIMITED.

HEAD OFFICE:
65 to 71 Front Street
West.
TORONTO, ONT.

CAPITAL,
$1,500,000.

FACTORIES:
Peterborough, Ont.

Branch Offices and Warerooms:
124 Hollis Street,
HALIFAX, - N. S.
1802 Notre Dame St.,
MONTREAL, - QUE.
350 Main Street,
WINNIPEG, - MAN.
Granville Street,
VANCOUVER, - B. C.

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Thomson-Houston Street Railway Generators and Motors
(Same as built by us for Niagara Falls Park & River Railway.)

Thomson-Houston Systems of Alternating Current Apparatus for Incandescent Lighting.

Edison-Systems of Low-Tension Direct Current Apparatus for Incandescent Lighting.

Electric Arc Lighting Apparatus. Electric Mining Apparatus.

Apparatus for Long Distance Transmission of Power.

WE MANUFACTURE IN CANADA EVERY DESCRIPTION OF ELECTRICAL MACHINERY AND ELECTRICAL SUPPLIES.

× × × × × × × × × × × ×

INSULATED WIRES

FOR ELECTRICAL USES

Our wire factory is one of the best equipped on the continent.

We manufacture every description of insulated wires and cables, and our large production enables us to offer special values.

We desire at this season to call attention to our

Standard Weatherproof Wires,
White Weatherproof Wires,
Rubber Covered Wires,
Magnet Wires,
Office and Annunciator Wires,
Flexible Incandescent Light Cords.

Our solid core Rubber Covered Wire has the best insulation resistance, best quality of rubber, and gives the most general satisfaction to users.

TRANSFORMERS

To no other class of apparatus can the axiom that "the best is the cheapest" be more truly applied than to electrical machinery and appliances. To transformers does this especially apply. It will pay you to buy the best in the market, and we now offer you the very best at such a reduced price that the essentials of quality and efficiency are combined with extremely low prices, which is rendered possible only by the introduction of improved labor-saving machinery, added to a large increase in our output.

The Transformer we offer is the improved type F. Thomson-Houston design, celebrated for its high efficiency and perfect regulation.

The following points in a Transformer are all essential: (1) Perfect safety; (2) high efficiency; (3) good regulation; (4) small core loss; (5) convenience in installation.

These are attained in the New Type F. Oil Insulated Transformers (which we are now manufacturing at our works at Peterborough, Ont.), in a greater degree than any other upon the market.

Write to nearest office for prices and discounts.

INCANDESCENT LAMPS

We have, during the past two months made such changes and improvements in our methods of manufacture, and in the general appearance of our lamps, that we offer you, with confidence, a lamp that we are assured is now superior to any other in the market.

We have adopted an entirely new method of treating and handling our carbons, and have so improved our methods of inspecting and testing throughout each department and process that all inherent defects are eliminated before the lamps are passed for shipment.

Price list and discounts furnished on application.

OUR LAMP SOCKETS ARE THE BEST AND CHEAPEST IN THE MARKET.

THE ART OF SUCCESSFUL ADVERTISING.

By Ernest H. Heinrichs.

Advertising has become generally recognized as a necessary and important adjunct to every business, trade, profession and mercantile or commercial enterprise. The cobbler advertises his handiwork on the window-ledge; the grocer puts his best stock of vegetables on the sidewalk; the clothier, the dry-goods man and the furniture dealer fill the pages of the newspapers; the actor seeks to attract the attention of the public in flaming posters, and the manufacturer advertises his specialties in the trade papers and magazines. The time worn axiom that good goods do not need advertising is now relegated into the deepest recesses of the business man's vault containing memories of the past, and is brought out only to serve as a dampener upon a two persevering advertising solicitor. In this age of keen competition, it is not likely that any man will have a purchaser for his goods simply because they have the characteristic of excellence. He must promulgate their distinctive advantages or their superiority.

To do this successfully, he must advertise. There are as many ways of advertising as there are roads leading to Rome, and the question is how to find the right one.

To the writer it seems that the first point to be considered is, how much money will the capital of the business to be advertised permit to be used for this purpose? This point, once disposed of, will immediately suggest another one,—how may this sum be expended to the best advantage, or, how can the business be advertised most effectually with this stipulated sum.

The thorough study of these points is of the utmost importance. There must be method pursued in the manner of advertising, if it is to be profitable, else there will be absolute failure. One who decides to embark in any enterprise invariably makes it his first business to find out how much it will cost him to make a start. The same principle applies to advertising. It is a business in itsself, the management of which requires the greatest care and attention.

Some people say that they give the papers an advertisement occasionally just to get on the good side of them; others, that they give some man from the papers an advertisement, because he is a "jolly, good fellow." In fact, one gentleman remarked to the writer some time ago that "there is a good deal of sentiment connected with advertising!" Now there is much truth in what this gentleman said, and more is the pity. It is this kind of advertising which is dangerous, inasmuch as it reflects upon advertising as a legitimate business, because it deteriorates to a form of bribery, and it disheartens as well as disgusts both the reputable publisher and the honest advertiser.

Having decided how much money may be spent in advertising, the next question is, how and where is it to be done? To settle this question is very difficult, for the reason that the mediums for advertising are legion. Many old advertisers believe that advertising by circular letter affords the surest and best way to reach a customer. They argue that if they send out a stamped envelope with a type-written page or two of matter inside, the recipient will surely read these pages. Then there are others, who are not particular about having the matter even type-written; they are satisfied to get up an elegant advertisement, have a printer strike oft as many copies as they have customers on their books, and then they send these circulars to their customers. Again, there are those who now and again get up a catalogue, in which are set forth descriptions in general and in detail of everything they sell, and they send these catalogues wherever they hope to catch a probable purchaser. Then there are firms who rely entirely upon their agents and representatives to advertise their goods by word of mouth. Most advertisers, however, consider all these methods auxiliary; they help a little, but they do not do much good alone. It may be safely asserted that newspapers, magazines, and trade papers, are now recognized as the standard advertising mediums.

The object of advertising is to make certain statements known to the public at large. Hence the more people see the advertisement the more thoroughly does it fulfil its mission. Of course this opinion may be questioned by the advertiser of specialties, who desires to reach a certain class of people only, but this statement is meant to apply to advertising in general, though it would require merely a slight modification to apply to all cases. Nevertheless, one fact, borne out by the most successful advertisers in America and in Europe, is that what is broadly understood by newspaper advertising is the best and cheapest advertising that can be had. The term "newspaper" includes of course periodicals of every class.

In choosing a publication some people have very peculiar ideas; if they see a paper with a large number of advertising pages, they take it for granted that an advertisement in such a paper means money thrown away, because the advertisement will be crowded out of sight. This is a mistake. The best papers, as a rule, have the largest amount of advertising; hence they must be the best advertising mediums. The best papers are apt to be the most widely read, so that advertisements in them must of necessity become widely circulated, which is the great object of advertising. To this reasoning it may be replied that it does not follow, that because an advertisement is circulated among ten thousand people, ten thousand people will read it. Certainly not, but an advertisement circulated among ten thousand people stands a better chance of being read ten thousand times than an advertisement circulated among only five thousand people. Apart from this deduction of simple logic it must not be forgotten that advertisements are read with as much interest as any other portion of a newspaper. This may not always have been so, but it is nevertheless true to-day. It may be that the busy man will carelessly pass over the advertising columns of the daily newspaper, but the housewife will read them twice and thus make up for his neglect. But take the popular magazines of to-day, the advertising pages of which are truly remarkable, not alone in their appearance, but also as regards their contents. Does any one dare to assert that an advertisement placed anywhere in these pages is a lost investment? The advertising pages of these periodicals represent from month to month the most striking reflection of the commercial, the industrial, and the financial, as well as the intellectual, progress of this country, and the intelligent readers of these publications are just as much interested in the perusal of the advertising pages as of the essays, stories and other features.

A business man, having decided to advertise, and having set apart a certain sum for this purpose, should go to that publication which is read by the largest number of people interested in his business, which most probably will be that publication which has the most advertisements and pays the most attention to the manner of setting up and arranging the advertising pages.

The advertising rates in the best publications are very low. Many people, and even some advertisers of experience, will doubt this statement, but that does not detract from its correctness. The trouble is we expect too much from an advertisement. It must not be supposed that a single advertisement, for which perhaps $50 has been paid, is going to fill a store with customers for a year to come, thus bringing a profit on the investment of probably ten hundred per cent. Most people are satisfied, if they make one hundred per cent. on their invested capital, and everybody should

.... THE ....

Reliance ... DYNAMOS
Automatic ...
Alternating Current ..

PERFECTLY AUTOMATIC,
FROM ONE LIGHT TO FULL LOAD.

MANUFACTURED BY

THE RELIANCE ELECTRIC MFG. CO.
(LIMITED)
WATERFORD, ONT.

Write for prices and investigate before
..... purchasing .....

BRANCH OFFICES:
106 King St. West, TORONTO, ONT.
749 Craig Street, MONTREAL, QUE.

commend them for their modesty. Why, then, should a larger profit be expected from an advertisement than from any other investment?

Advertising once commenced, must be kept up, and if conducted with the same thoughtfulness, the same care, and the same business methods exercised in any other enterprise, an advertisement will always prove a profitable investment.

There is one other feature connected with the business of advertising, which, although the writer has so far not made mention of it, is nevertheless of no less importance than the others. This is the manner of composing an advertisement. It is impossible to form any set of standard rules as a guide for the composition of advertisements, except in so far as that they should in all cases be so worded that they will at once attract attention and be read. To be brief, concise, clear, and to the point in writing an advertisement is undoubtedly commendable, and a plain statement is always more liable to carry weight with the reader than a long string of ambiguous phrases, which have no defined meaning when analyzed.—*Engineering Magazine.*

SPARKS.

The capital stock of the Vankleek Hill, Ont., Electric Light Co., has been increased from $3,000 to $10,000.

Steps are being taken to establish telephonic communication between Denmark and Sweden, under the Sound.

Mr. A. J. Corriveau, of Montreal, has registered his business under the name of the Canadian Electric Manufacturing and Supply Co.

At the recent annual meeting of the Brantford Electric and Power Co. Mr. William Benen, the president, was re-elected, as were also the other directors of the company.

The new electric mail cars recently put in operation at Ottawa, have given very satisfactory results, having reduced by 75 per cent. the time necessary for the delivery of the mails.

Messrs, Robin & Sadler have received from the Eastern Townships Agricultural Association, a silver medal, for their display of leather belting at the Sherbrooke Exhibition, in September last.

The Bell Telephone Co. gives notice of its intention to apply to Parliament at its next session for an Act to increase the borrowing powers of the company to the limit authorized by the "The Companys' Act."

A limited joint stock company is being formed at New Hamburg, Ont., composed of leading citizens of that town, with a capital of $50,000, to manufacture a new air motor and an electric dynamo. The company expect to commence operations early in the new year,

Messrs. Doty Bros. & Co., of Toronto, recently removed from the hull of the steamer "Sadie," at Oakville, Ont., what is believed to be the oldest marine engine in Canada. The engine was built at Birkenhead, England, in the year 1804, and parts of it have been in use constantly up to the present time.

A correspondent fo the ELECTRICAL NEWS in London, Ont., advises engineers, instead of purchasing an indicator, to study Hemmenway's or Pray's Indicator Practice. He expresses the opinion that it would be better for them to possess themselves of the theory of the indicator, than to have an indicator without the knowledge which should precede its use.

It is said to be the intention of the Montreal Street Railway Co., to have all its cars vestibuled, thus affording shelter to the motormen and conductors. In a climate so severe as that of Canada in winter, the comfort of street railway employees as well as the safety and comfort of passengers, demand that this protection should be afforded. We observe that in some of the American States laws have been passed making it compulsory on street railway companies to place vestibules upon their cars.

Messrs. F. Nicholls, general manager of the Canadian General Electric Co., and Mr. H. P. Dwight, general manager of the Great North-Western Telegraph Co., have lately returned from a visit to British Columbia. A Vancouver dispatch intimates that their visit had something to do with the purchase by the city of Vancouver of the Victoria and Westminster Tramway, the Vancouver City Tramway, and the Westminster City Tramway, as well as the entrance into British Columbia of the Great North-Western Telegraph Co., as a competitor of the Canadian Pacific Telegraph Co.

At a recent meeting of the City Council of Ottawa, Ont., the following resolution was adopted:—"That in view of the necessity of the city providing its own electric lighting plant for street lighting and other purposes, the city clerk be instructed to write the Ottawa Electric Light company and ask on what terms they would be willing to sell their plant, giving the details of the cost of the machinery on hand and the water power privileges they possess in approximate horse power with a view of opening negotiations for the purchase of the same, and that the company be asked to return an answer before the 15th December."

THE HAWORTH BELTING CO.

MANUFACTURERS

OFFICE AND FACTORY: 9 AND 11 JORDAN STREET,

TORONTO

The Imported

English Liquid Vegetable "Anti-Scale"

.... IS THE ....

BEST BOILER COMPOUND FOR LOCOMOTIVE, MARINE and STATIONARY BOILERS.

Efficient in its working without injury to the boiler plates and tubes.

TOTALLY PREVENTS SCALE ... REMOVES INCRUSTATION, CORROSION AND PITTING ... PRESERVES THE PLATES AND TUBES

PREVENTS LEAKAGE OF BED TAPS, WATER GAUGES, ETC.

This compound is purely vegetable, proves reliable, and worthy of use by all engineers.

Used in Great Britain and the Colonies.

TESTIMONIALS REFERRING TO ITS EXCELLENCE, AND EVERY INFORMATION CHEERFULLY GIVEN ON APPLICATION TO

S. FUGE

(Agent for John C. Taylor & Co., Ltd., Manufacturers, Bristol, England)

436 Richmond Street . . . . LONDON, ONT.

The Reliance Electric Manufacturing Co., of Waterford, Ont., are seeking to obtain from the City Council of Toronto, permission to string wires and erect poles for the supply of electric light and power in the extreme western section of the city. They propose to use the old Parkdale water works pumping house as a power station, if it can be obtained for this purpose.

A half-inch three circuit metallic sub-marine cable of the best quality, upwards of 3,000 feet in length, was recently laid under the Fraser River by the Burrard Inlet Telephone Co. The laying of the cable occupied about three hours, and was done under the supervision of Mr. H. W. Kent, Manager of the Company, and Mr. George C. Hoidge, the manager of the local system. The first message over the new line was sent by the president of the company, Mr. J. C. Armstrong.

The steam and electric power plant of the New Westminster and Vancouver Electric Tramway Company, as well as the cars with which their line is equipped, amounting in value to nearly a quarter of a million dollars, are housed in one large wooden building. Mr. F. E. Handy, on assuming the superintendency of the line, was forcibly impressed with the danger to which this valuable property was exposed from fire, and immediately set to work to devise ways and means for its protection. For this purpose he organized the employees into a volunteer fire company, and placed in position a steam whistle, to the sound of which they were to respond. The men were drilled at regular intervals, and so efficiently, that at a recent inspection of the works by representatives of the City Council, only ten seconds elapsed between the sounding of the whistle and the turning on of a stream of water from the hose.

PULLEYS MACHINE MOULDED STEEL RIM AND GRIP
Steel Rim Pulleys are practically unbreakable, are lighter and easier on shaft, and cost same as cast pulleys.
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(BRANTFORD, CANADA) **WATEROUS**

SPARKS.

It is reported that a strong company has been organized to build an electric car line from Rat Portage to Keewatin.

The married employees of the London Street Railway Company were each presented with a Christmas turkey by the company.

$70,000 of stock of the Hamilton, Grimsby and Beamsville Electric Railway Co. has been subscribed, and $10,000 paid up. Only half the authorized capital stock of $200,000 will at present be issued.

The London West Electric Railway has been operated without much difficulty during the recent severe storms, but great difficulty has been experienced in giving a good service with horses in the city.

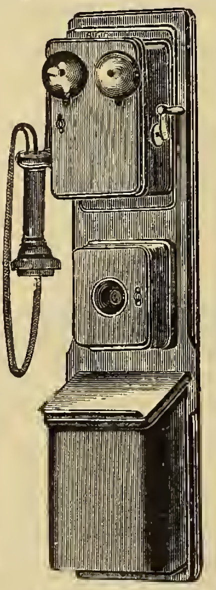
As a result of a recent conference between the managers of the Toronto Street Railway and the Toronto City and Suburban Electric Railway, the Toronto company agreed to put electric cars as soon as possible on Bathurst street to connect with the suburban line.

The manufacturers of the Novak incandescent lamp, in the suit brought against them in the United States courts by the Edison Electric Light Co., for infringement of the Edison patent, admit the validity of that patent, and set up as their sole defence the claim that the lamp which they manufacture is non-infringing. The decision of the courts in this case will be looked for with very great interest in view of the contention upon which the defendants base their case.

The following tenders for the supply of an electric and steam plant have been received by the City Council of London, Ont. :

Company.	Electric Plant.	Steam Plant.
Standard Co.........	$43,130	$15,565
Canadian Gen. Co....	36,300	
Fort Wayne Co......	42,224	
Reliance Co.........	32,990	
Royal Co............	42,650	
Western Co..........	42,274.59	15,565
Siemens-Halske Co..	656,90 complete.	
Robb.Armstrong Co.		14,700
E. Leonard & Sons..		15,565
Inglis & Son.		17,000
Babcock & Wilcox...		10,979
T. A. Grant & Co....		8,550

The Canadian General Electric Co. offer the present city plant at the price of $32,670. A meeting of the City Council has been called to consider the tenders.



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... and ...
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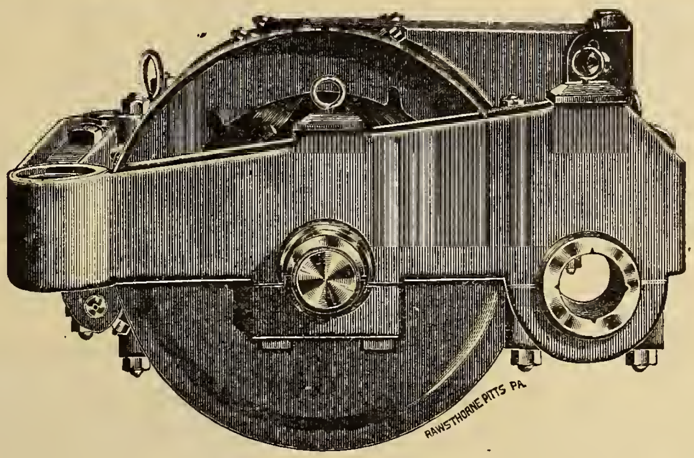

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TRADE NOTES.

The Canadian Pacific Navigation Co., Ltd., of Victoria, B. C., last spring gave a trial order to Mr. S. Fuge, Canadian agent, London. Ont, for 20 gallons of "Anti-Scale". They are so pleased with its use, that they have now ordered 150 gallons.

"Business is rapidly improving with us." So say the Fenberthy Injector Co., of Detroit, Mich. They add that their November sales are nearly double their October business, and that they are again running their factory on full time and with a full force.

The Robb Engineering Co., of Amherst, Nova Scotia, have been awarded a contract for two 250 h. p. cross-compound high speed engines for street railway and light for the Amherstburg & Sandwich Street Railway Co., and two additional Monarch boilers of 200 h. p. each, for the Canadian General Electric Co.'s new electric station at London. These boilers will complete a battery of five Monarch boilers, making 1,000 h. p. in all.

Messrs. Darling Bros., of Montreal, have furnished the Hamilton Electric Light and Power Company with one of their 18″ Transmitters to drive a large generator; also two 9″ Transmitters to the Ontario Government for Central Prison, Toronto, to drive two Reliance dynamos. They have likewise disposed of 125 Morse valve reseating machines since the first of January, 1893, amongst these sales being the railroads, cotton mills, electric stations, etc.

November has been a busy month with the Waterous Engine Works Co., Ltd., Brantford. In addition to four large marine boilers, they have received orders for four complete circular saw mills from 30 to 75 H. P., four single set of saw irons, ten standard chopping mills, three large under runner mills, one Prescott direct acting steam feed, and three Allis band mills with their attendant machinery, one pulp wood outfit, and two shingle mills, one veneer machine and a number of export orders. The company have also made arrangements with the W. E. Hill Co., of Kalamazoo, to manufacture their steam mill specialities.

SPARKS.

The British training ships have lately been connected by telephone with the Royal Navy Barracks at Keyham.

A movement is on foot with the object of federating the various unions of street railway employees throughout Canada.

The Gananoque Electric Light Co. are about to install a new 200 h. p. compound engine, manufactured by John Inglis & Son, Toronto.

The village council of Grimsby, Ont., have refused to grant right of way through the village to the Hamilton, Grimsby and Beamsville Electric Railway.

A telephone line is to be constructed by the Bell Telephone Co., from Danville to Duddsville, Que., via St. George, Wotton, St. Camille and South Ham.

The new Factory Act which is up for consideration before the Legislature of Quebec provides that employers must have a certificate showing that their steam boilers and attachments have undergone proper inspection.

It is stated that a suit for $20,000 has been issued by the sisters of the late F. W. Scobie, against Messrs. W. A. Johnson, Toronto, and Phillips Johnson, Montreal, of the Ball Electric Co., and the Canadian General Electric Co. The suit is said to relate to their deceased brother's interests in these companies.

The earnings of the Toronto Street Railway for the month of November last were $69,207, as against $63,574 in the same month in 1892, and $60,412 in 1891. It is believed that the doubling of the ratio of increase this year is due to the recent adoption of transfer tickets. There is no doubt whatever that under the loose system which prevailed prior to the adoption of tickets, a great deal of free riding was done.

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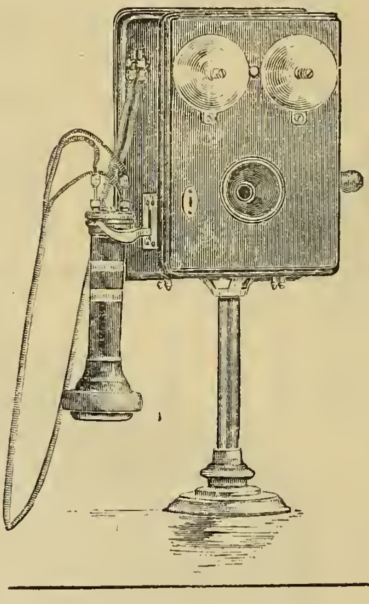

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Queen Street.

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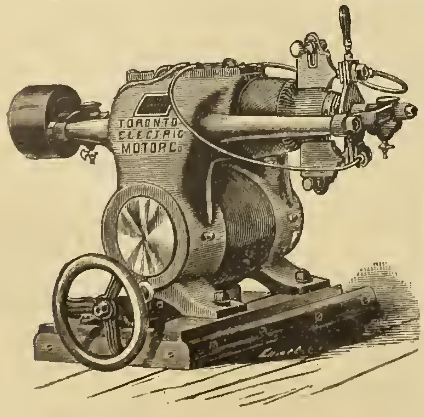
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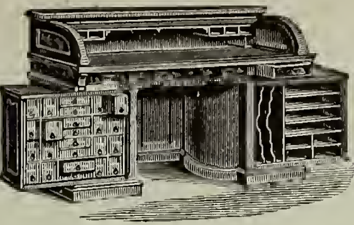

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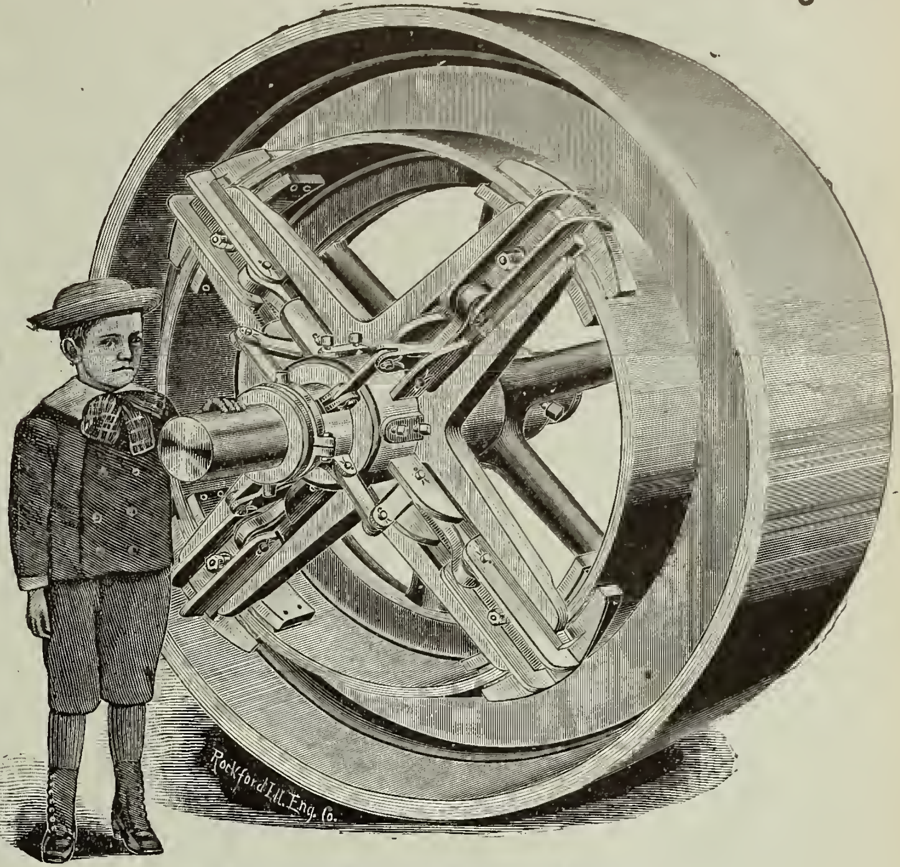
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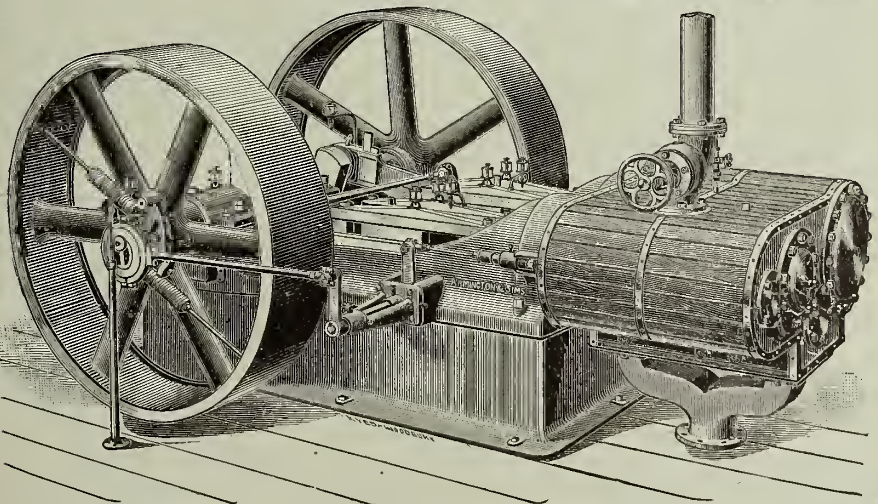

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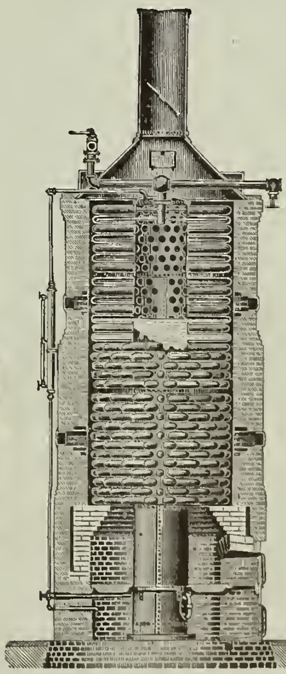

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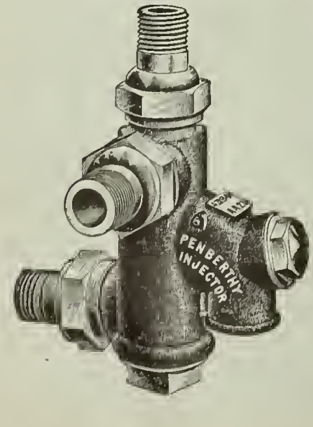

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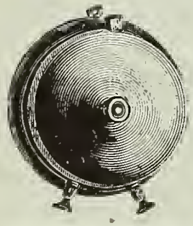

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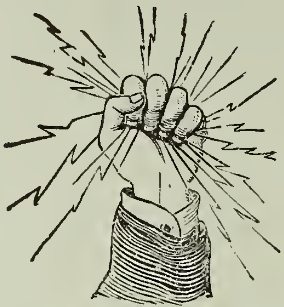

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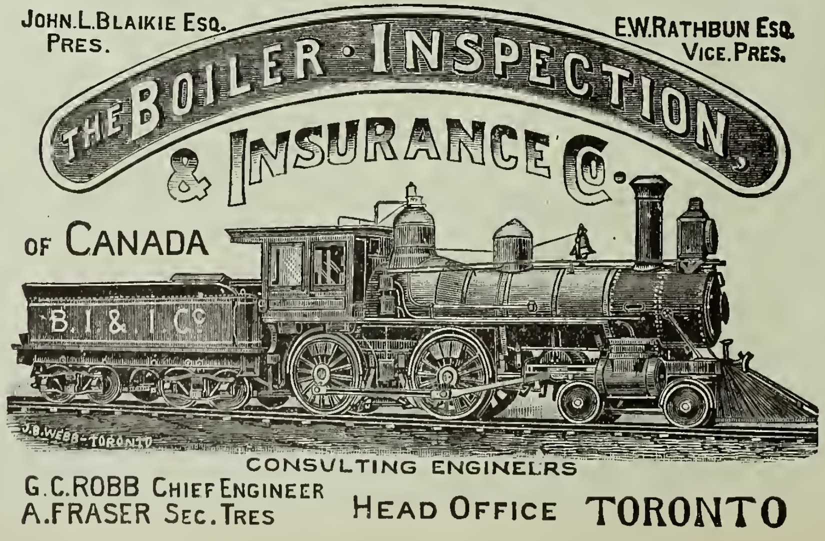

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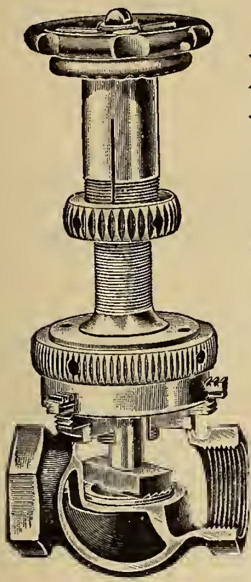

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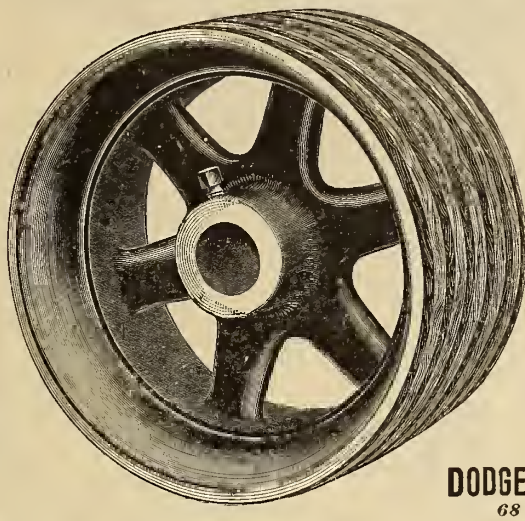

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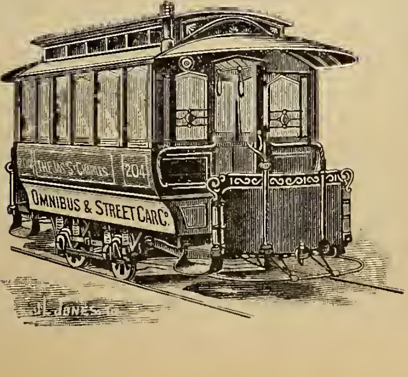
JAS. ST. CHARLES, Manager.



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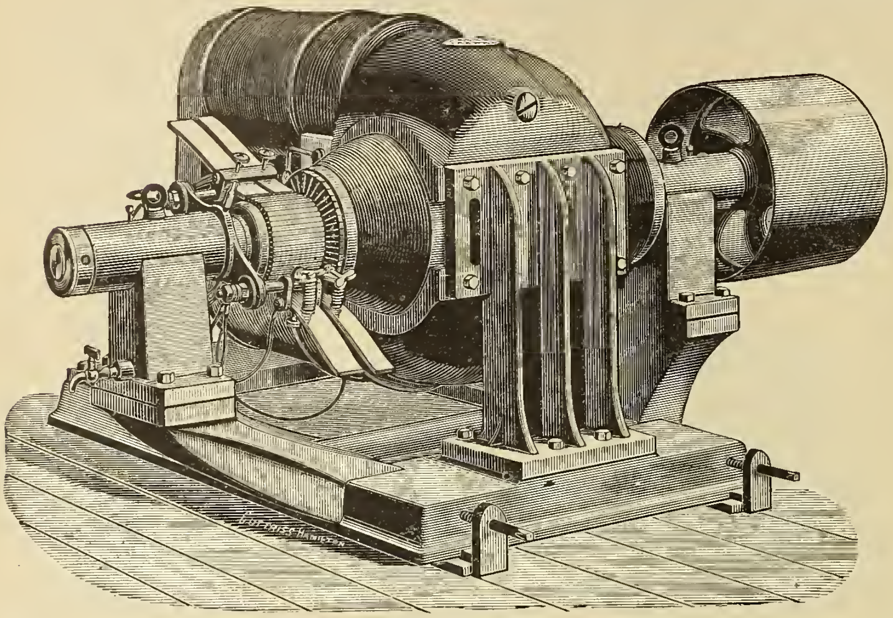

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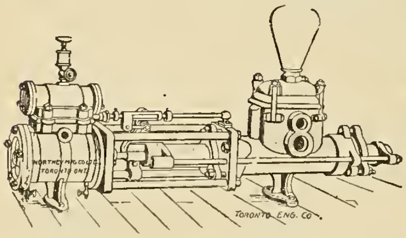

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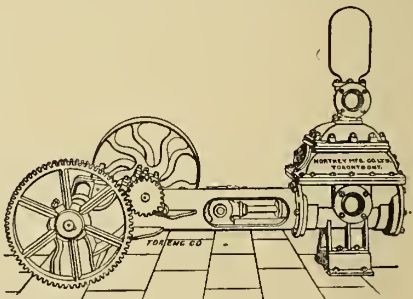

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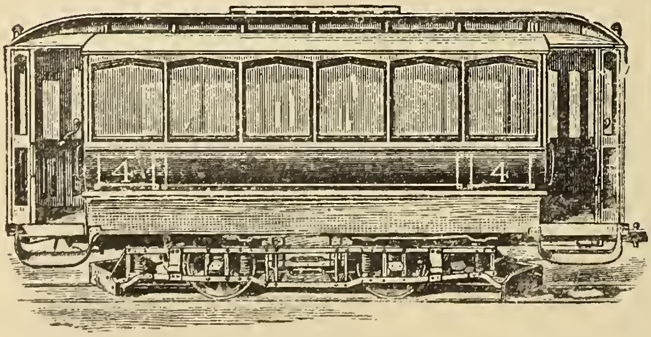

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STE. JULIE, Sept. 5th, 1892.
T. W. NESS, ESQ., Montreal.
DEAR SIR,—We are happy to state that your telephones and switches are giving us good satisfaction. We have three sorts of switches and we find yours far preferable. There are now about forty of your telephones in operation on our line. Every one works well, and we intend to use no other.
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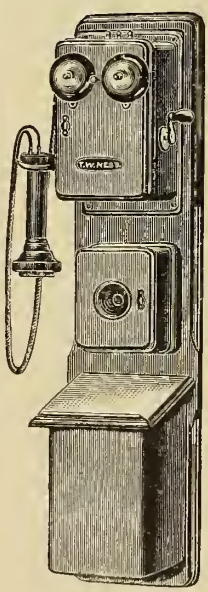

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CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. IV. FEBRUARY, 1894 NO. 2.

THE ADAPTABILITY OF AN EDISON THREE WIRE PLANT.

By JAMES MILNE.

THE electrical plant of the Incandescent Light Co., of Toronto, Ont., consists of two 200 K. W., driven direct, four 100 K. W. and six 60 K. W. belt driven generators of the ordinary Edison type, shunt wound for 140 volts. The Company at present are supplying light and power on the three wire system, and also power for street railway purposes at from 500 to 650 volts. It is not necessary to describe in detail the working of the three wire plant, as that system is fairly well understood by the electrical fraternity; but a short description of the switch-board as it is arranged at present, together with the manipulation of same, will not be out of place.

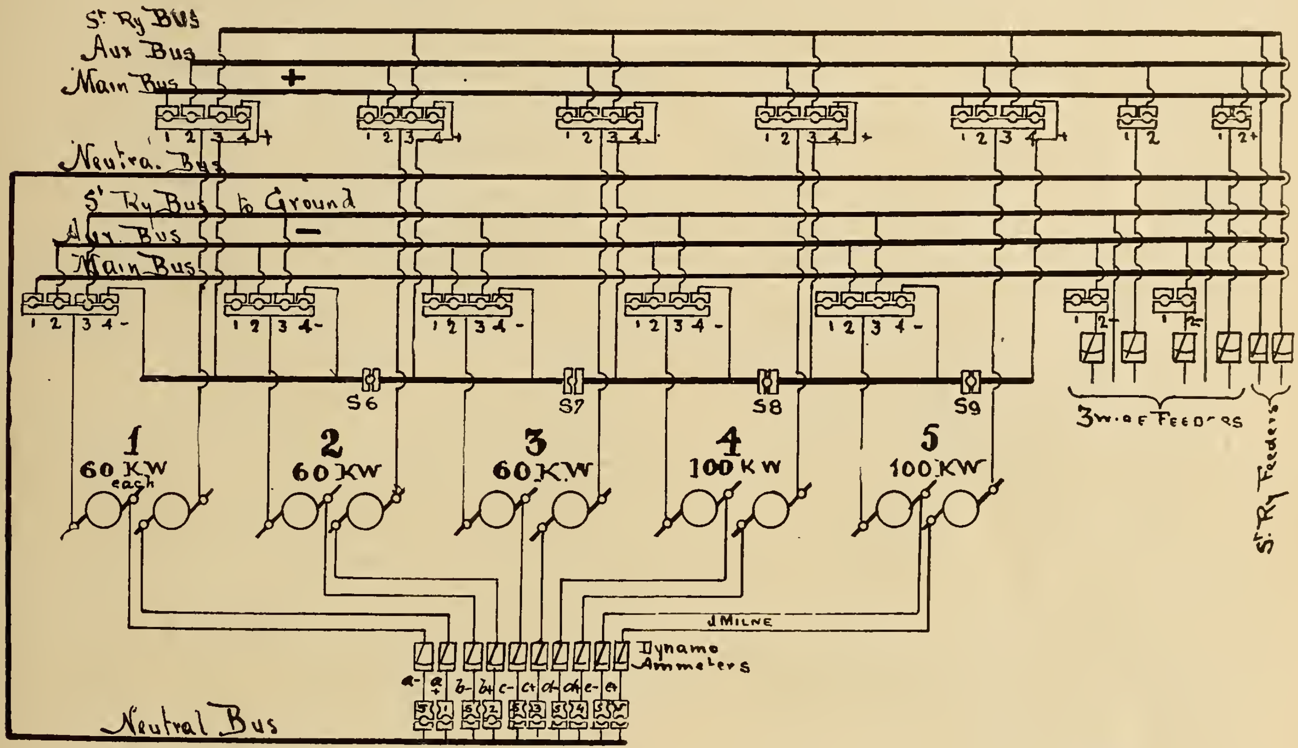

FIG. 1.—MILNE'S ARRANGEMENT FOR SUPPLYING LIGHT AND POWER AT 125, 250, 500, 1,000 AND 1,500 VOLTS.

The switch-board is arranged for running on two pressures, and by dividing the auxiliary bus three different pressures are run—this being found necessary owing to the distributio nof the load and the losses on certain feeders at certain times. In re-arranging the switch-board for the supplying of the 500 volt current, it had to be taken into consideration that this power could not be supplied by any particular set of dynamos, for various reasons, and also that the present three wire system had not to be interfered with; so that the generators could be switched in on the three wire or on the street railway system with the least possible delay. The accompanying sketches show very clearly how this was done.

As seen on Fig. 1, there are 4 switches on the + and − poles of each pair of dynamos. These are marked 1, 2, 3 and 4 + and −, and are for main, auxiliary, street railway and special bus bars respectively. The object of this special bus, as it has been termed for convenience, will be seen later on. The reader will please bear in mind that the three wire plant is in operation 24 hours per day, and it will easily be seen that should any error be made in the manipulation of the switches, it simply means disaster to some of the armatures. As no mistakes have occurred so far, we may safely assume that same will not happen.

We will now suppose that the dynamos marked 1 – 3 on Fig. 1, representing two pairs, are to be cut in on the street railway system. All main and auxiliary switches on these machines, together with those leading to the =|= bus, are opened. This cuts out these generators from the three wire system entirely. All machines are now brought up to the same potential as indicated by the galvanometers, then close S1 S3 (shown between ammeters and =|= bus). This has simply the same effect as closing the =|= switches, but being disconnected from the neutral bus. Close switch 4 + on No. 1 dynamo, and 4 − on No. 3. The special bus has now connected the four machines in series, switch 3 − on No. 1 generator is now closed, *i. e.* the − pole of the series is connected to ground, and all that now remains to do is to close the final switch 3+ on the No. 3 machine. Before this is done, however, care is taken to have the pressure the same as that of the bus bar. This is seen by galvanometer or voltmeter as in common practice. The arrangement is shown very clearly in Fig. 2, omitting the lower parts of the diagram. All switches are marked so as to agree with Fig. 1.

When two pairs of machines are running and it is necessary to cut in one and out another pair, Fig. 2 illustrates the method adopted. The diagram so clearly shows the arrangement that it is unnecessary to describe it. Two 100 K. W. generators can quite easily be switched in and the load transferred from two 60 K. W. with no trouble whatever; the only precaution to be taken is to have all machines doing precisely the same amount of work.

In figure 3 there are shown four pairs of generators in series multiple, supplying current at 500 volts, and also part of the current generated by one pair being supplied to the three wire system. One pair of the 100 K. W. is running at 400 amperes at 250 volts, while the other pair is generating 700 amperes at 250 volts. Therefore it will be seen that 300 amperes at 125 volts are being supplied by each of these 100 K. W. generators to the three wire system, and still in connection with the 500 volt system. This, of course is simply a modification of a 5 wire system, and has given excellent results.

The writer was a little dubious as to the successful operation of this latter method, but as the load at 500 volts is remarkably steady, the variation in pressure is unobserved in the lights. The only serious objection to the running of the machine as in Fig. 3 is, that one of the poles on the light system is grounded. This in itself is harmless, provided all the rest of the system is free of grounds.

By again referring to the special bus of Fig. 1, it will be observed that any pressure from 125 to 1600 volts can be obtained.

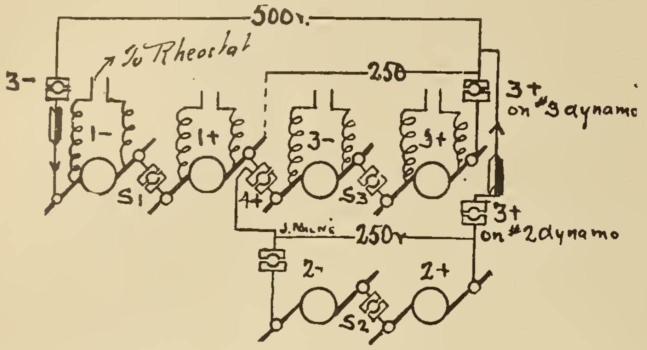

Fig. 2.

By simply opening the switches marked S_6, S_7, S_8, S_9, and closing 4 – and 4 + on all machines, the latter pressure can be obtained. As we have had no occasion so far to run at this pressure, I cannot say how same would operate, but judging from the excellent results obtained by the method described already, I don't think that any difficulty would be experienced whatever. It may appear to the reader that the method in operating the 500 volt circuit is rather complicated, but when you take into consideration that any two pairs of machines can be started up and cut in on the 500 volt circuit in three minutes, without any undue hurry, it shows very clearly that any complications that might appear on paper do not affect the practical working whatever. The machines running on the 500 volt circuit can be cut in on the three wire in less than ¾ of a minute.

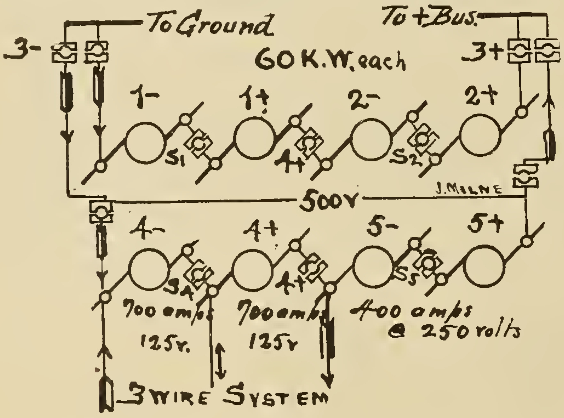

Fig. 3.

The writer has no knowledge of any other plant except the above being operated as per the sketch outlined, and I suppose there are very few even in the world where the same would be required.

LECTURES ON ELECTRICITY AT McGILL UNIVERSITY.

Following is an outline of a course of twelve evening lectures on Electricity to be delivered by Prof. Cox, at McGill University Montreal, for the benefit of persons whose circumstances are such as to prevent them from taking a regular course of study in the electrical department of the University:—

1. Introductory. Elementary Properties of Magnets. Identity of Frictional and Current Electricity. Production of Currents by Batteries and Thermopiles. Effects of the Current. Storage Batteries.

2. Measurement of Laws of Flow Current. Potential and Electromotive Force. Resistance. Practical Units and Instruments. Law of the Development of Heat by flow of Currents through Resistance.

3. Induction of Currents in Neighboring Circuits. Self-induction. Farady's Conception of Lines of Force.

4. Applications to the Electric Telegraph and Telephone.

5. The Dynamo Conversion of Mechanical into Electric Energy. Reconversation of Electric into Mechanical Energy by the Motor. The Transformer.

6. The Electrical Transmission of Power.

7. Theories and Modern Views of Magnetism.

8. The Electromagnet and its Applications. Designs of Electromagnets for Special Purposes.

9. Thunderstorms and the protection of buildings from Lightning. Change of views in recent years.

10. The relation between Electricity and Light. Radient Electricity. Maxwell's Theory and Hertz's Experimental Proof, that both are conveyed by the medium—the Ether.

11. Electricity as a Revealer. Crook's and the "Fourth State" of Matter.

12. Modern Views of the Structure and Functions of the Ether in relation to Light, Electricity, and the constitution of Matter.

Through the kindness of the Governors these lectures will be held in the Physics' Building, at McGill, and will be continued every Friday evening, beginning January 26th.

Tickets for the course: To members, $1.00: Non-members, $2.00.

The issue of tickets is limited to 200, on account of the size of lecture room.

CONSTITUTION OF THE MONTREAL ELECTRIC CLUB.

1. This society shall be called the "Montreal Electric Club."

2. The object of the club shall be, primarily, the advancement of members' knowledge in electrical science.

3. The officers to be president, vice-president, secretary and treasurer, also a committee of management composed of officers of the club and three members to be elected yearly. This committee shall not be considered a quorum of the club; the assent of the majority of the committee to be necessary to transact its business.

4. Members to be notified of all club meetings one week in advance.

5. The annual fees of both members and associates, to be three dollars, payable in advance, in instalments of one dollar each, on the following dates; 1st January, 1st April, 1st September; and must be paid within the month. Members two months in arrears to forfeit their membership, but may be reinstated by application to the committee and by payment of all arrears.

6. Names and addresses of candidates for membership are to be handed to the secretary in writing, showing the proposer, seconder, and qualifications of said candidates, they to be balloted for at next regular meeting of the club. Three black balls shall disqualify a candidate.

7. The club to meet once every fortnight at 8 o'clock.

9. The order of the proceedings at meetings to consist of
   - *a.* Minutes of last meeting read by secretary.
   - *b.* Report of committees.
   - *c.* Balloting for members,
   - *d.* Questions and suggestions by members.
   - *e.* Exhibition of apparatus, etc.
   - *f.* Reading of papers.
   - *g.* Discussion of papers.

9. Members of the press may be admitted to meetings, whose notes of proceedings are subject to revision by the chairman at his discretion.

10. Seven members shall form a quorum to transact business of the club.

11. Any member shall have the privilege of introducing a guest to the club meetings, who shall have the privilege of hearing and discussing papers.

12. Election of officers shall be by ballot, to take place at the annual meeting, of which notice shall be given.

13. Qualifications necessary for membership.

Members.—Those actively engaged in any branch of the electrical profession, and students in electricity equal to third and fourth years at McGill University.

Associates.—Business managers of electrical firms, and members of other branches of the engineering profession. Associates to have full club privileges, with the exception of holding office.

14. A candidate elected during any quarter shall pay the full dues for that quarter.

At the forty-seventh annual meeting of the Montreal Telegraph Company, held in Montreal during the past month, the annual statement showed the following satisfactory condition of the company's financial affairs:

ASSETS.	
Telegraph lines	$1,625,890 00
Telegraph cables	33,487 39
Offices and equipment	212,500 00
Real estate in Montreal, Quebec, Ottawa and Toronto	279,946 46
Cash, accounts, receivable stock, etc	97,376 96
Total	$2,249,200 81
LIABILITIES.	
Shareholders' capital	$2,000,000 00
Dividend No. 118, payable 15th January	40,000 00
Unclaimed dividends, etc	1,288 40
Total	$2,041,288 40
Surplus of property over shareholders' capital	151,823 85
Contingent fund	56.088 56
Total	$2,249,200 81

The company's only liability is to the shareholders (1) for their capital stock, (2) for dividend No. 118, payable on the 15th instant, and (3) for unclaimed dividends, as shown in the foregoing statement. The extensive property of the company remains free from debt or encumbrance of any kind, and its continued maintenance and repair by the Great North Western Telegraph Company is provided for under clause 2, and guaranteed by the Western Union Telegraph Company in the last two paragraphs of the agreement between the companies. The old board of directors was elected as follows: Messrs. Andrew Allan, president; Hector Mackenzie, Jesse Joseph, William Wainwright, Henry Archibald, William Rae, Henry Yates, whilst Mr. D. Ross Ross was re-elected secretary-treasurer.

WESTMINSTER AND VANCOUVER TRAMWAY.

By F. E. Handy.

This road (until recently 16 miles long) extends 12 miles between the cities of Vancouver and Westminster, exclusive of 6 switches or sidings. The gauge is four feet eight and a half in.; it is laid with 40 lb. T rails, on a roadbed which almost follows the natural grades of the land, through several miles of virgin forests, lined on either side with tall Douglas fir trees. The line crosses four trestle bridges, the highest of which is 86 feet and 120 feet long. The grades on this road are 5, 6, 7, 9 and 11%, so that the machinery at power house has occasionally to stand very severe changes of load.

The right of way has been slashed and burned the entire length and width, and all tall trees liable to fall on wires or track have been cut down. Cedar poles 25 feet above ground, with stretching wires in both cities' limits, and brackets in the urban sections support the trolley wires, carry feeders and telephone wires along the entire system. A copper return wire is laid between the rails and cross bonded every alternate pair of rails.

D. OPPENHEIMER,
President Vancouver and New Westminster Electric Tramway Co.

WIRES.

Owing to the position of power house (3 miles from Westminster and 9 miles from Vancouver), a large amount of copper for feeders is necessary on the Vancouver end to obviate the loss on line. No. 4 B. & S. trolley wire is used, with the exception of the short line, which is No. 2 B. & S., feed wires No. 0000, 000, 00, 2 and 4, of which there is on poles 138,100 lbs. By means of a metallic return telephone system with instruments on all cars it is possible to call up the power house or the terminus offices from any part of the road.

CARS.

The car equipment consists of two Brill passenger cars, 26 feet bodies, 35 feet over all, with smoking compartment, full vestibuled, on Brill steel double tracks, fitted with two 30 h. p. No. 16 Edison single reduction motors, electric heaters and brakes; one Brill combination baggage and passenger car, dimensions and equipment same as above; four Brill passenger cars, 25 feet bodies, 35 feet over all, vestibuled, on Brill steel double trucks fitted with 2, 12a, 25 h. p. S. R. Edison motors, heaters and electric brakes. The above cars are wide and roomy and nicely upholstered, and have carried at Fair time 110 passengers each. Three Patterson & Corbin, St. Catherines passenger cars, 16 ft. bodies, on Brill trucks, fitted with two 15 h. p. D. R. Edison No. 6 motors. One freight car, 23 feet long, fitted with two 20 h. p., No. 14 S. R. Edison motors, used for carrying rails, ballast and heavy freight business. The usual tower cars, handcars, railway velocipedes and a tank car are in the barn.

BUILDINGS.

The power house contains boiler room, engine room, car barn, machine shop, store room and superintendent's office.

A boarding house for employees is erected near the power house, and close by are brick oil house, blacksmith shop, etc.

The boiler room contains two batteries of boilers, comprising four 125 h. p. Doty tubular boilers and three 100 h. p. tubular boilers (Ball Engine Co.), to which are connected two steel smoke stacks, 90 and 60 feet high respectively. A track is run into this room with truck carrying four cords of wood, from which the fires are fed.

Two 10 h. p. pumps supply the boilers with surface water from large tanks sunk in the ground, the water has to pass through a 500 h. p. feed water heater for the large boilers and through two 150 h. p. heaters for the smaller ones.

The engine room contains two 250 h. p. "Ideal" high speed engines, belted to two 200 killowatt 500 volt Edison railway generators; two 150 h. p. high speed Leonard Ball engines, belted to two 100 killowatt 500 volt Edison generators; large birds-eye maple switch-board fitted with the usual ammeters, voltmeters, four Westinghouse automatic switches on marble bases, also main line and equalizing switches.

During six days water famine in Vancouver current was supplied to the Vancouver street railway system, 9 miles away, giving slow but sure transit.

This line carries all the Northern Pacific passengers and baggage from southern points to Vancouver, and does a very creditable business.

The city service of Westminster is very small and unprofitable largely on account of the severe grades and numerous curves required to travel from south to north.

It is the intention of this company to extend their line to Sapperton, one mile up the Fraser, and to Lulu Island, some five miles down the Fraser, where it will do an immense business with the farmers. I have taken ampere readings both in power house and on cars which will appear later in this paper, showing the great difference in load on account of the severe grades on this road.

The officers of the company are: D. Oppenheimer, President; B. Douglas, Vice-President; P. N. Smith, Sec.-Treas.; H. Henlow, agent.

Mr. D. Oppenheimer, the president, whose portrait, together with that of Mr. F. E. Handy, the general Superintendent, we present to our readers herewith, is one of the most public-spirited, large-hearted men of the city and province. In conjunction with his brother he has built up one of the largest wholesale grocery businesses on the coast. He was for several years the mayor of Vancouver, in which capacity he performed valuable service on behalf of the city. His purse is ever at the disposal of philanthropic objects. As President of the Westminster and Vancouver Tramway Co., he has manifested his ability, and is held in much esteem by the officials and employees as well as by the travelling public.

F. E. HANDY,
Manager Vancouver and New Westminster Electric Tramway Co.

PUBLICATIONS.

The publishers of the Electrical World have reduced the size of the pages in that journal, and by so doing have greatly improved its appearance and enhanced its convenient handling.

Money and Risks is the name of a new Canadian monthly journal which has been established to succeed The Budget. It is designed to be an authoritative review of insurance, financial and commercial opinion. The first number is creditable in appearance and ably written. The price of subscription is $2.00 per year. The Parr Press Co., publishers, 78 Wellington Street West, Toronto.

The Brush Electric Co., of Cleveland, who are the owners of most of the stock of the Trenton Electric Company, Trenton, Ont., have appointed Mr. S. M. Wheeler to succeed Mr. W. J. Clarke, as manager of the company. It is said to be the intention of the Brush Company to put the plant in a state of first-class efficiency, and if sufficient encouragement be obtained, to add to the plant machinery to supply incandescent lighting.

An enterprising Montreal electrical supply firm are advertising electric fans for a new purpose, viz., that when placed in store windows and connected from an incandescent light so that a current of air is directed against the glass, they dispel moisture and thus prevent the window from being covered with frost. Hitherto the business season for electric fans has been a comparatively short one, and it will be a satisfaction to supply firms to know that use has been found for them in winter.

CANADIAN
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STEAM AND ENGINEERING JOURNAL

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Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 25th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 22nd day of the month.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free. for $1.00 per annum, 50 cents for six months. The price of subscription may be remitted by currency, in registered letter, or by postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters must be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union, $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. *When ordering change, always give the old as well as the new address.*

The Publisher should be notified of the failure of subscribers to receive their papers promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal

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MONTREAL BRANCH NO. 1.—Meets 1st and 3rd Thursday each month, in Engineers' Hall, Craig street. President, Jos. Robinson; first vice-president, H. Nuttall; second vice-president, Jos. Badger; secretary, J. J. York, Board of Trade Building; treasurer, Thos. Ryan.

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BRANDON, MAN., BRANCH NO. 1.—Meets 1st and 3rd Friday each month, in City Hall. A. R. Crawford, President; Arthur Fleming, Secretary.

GUELPH BRANCH NO. 6.—Meets 1st and 3rd Wednesday each month at 7:30. p.m. C. Jorden, President; H. T. Flewelling, Secretary, Box No 8.

OTTAWA BRANCH, NO. 7.—Meets 2nd and 4th Tuesday, each month, corner Bank and Sparks streets; J. H. Thompson, President; Wm. O'Brien, Secretary.

DRESDEN BRANCH NO. 8.—Meets every 2nd week in each month; Thos. Merrill, Secretary.

BERLIN BRANCH NO. 9.—Meets 2nd and 4th Saturday each month at 8 p. m. W. J. Rhodes, President; G. Steinmetz, Secretary, Berlin Ont.

KINGSTON BRANCH NO. 10.—Meets twice each month over No. 1 Fire Station. J. Devlin, President; A. Strong, Secretary.

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Information regarding examinations will be furnished on application to any member of the Board.

THE annual convention of the National Electric Light Association of the United States will be held in the city of Washington on Feburary 27th and 28th, and March 1st.

THE secretary of the Montreal Electric Club reports requests from New Orleans, St. Louis and Toronto for copies of by-laws. The first named place has started an electric club on somewhat similar lines. We trust Toronto will now have a try at it.

A RECENT number of the Electro Technicker describes an improvement in arc light carbons, as used by the firm of Krupp, in Essen, which consists in saturating the carbon, or mixing the carbon paste from which they are made with hongstic acid or tungstates.

AN ENGLISH contemporary draws attention to the fact that many stations could well afford to change their transformers. This is no doubt the case in Canada, too, where the old type of transformer is used, which is on practically no load during the day and probably wasting quite a lot of current by its inefficiency.

There are some cities in Canada in which electric companies furnishing power supply also lamp renewals free of cost. These companies could easily settle the momentous question of the "smashing point" of lamps by reducing their price for current and allowing the consumer to buy his lamps when and where he had a mind to.

AT McGill College, Montreal, a university extension course of twelve lectures on electricity will be delivered by Professor Cox. This is a step in the right direction. Many an electrical student, who unfortunately has not the means of going through college, but who would be willing to study hard, has no chance of so doing, his time being occupied during the day by his work, and in the evenings all such sourses of education being closed up.

IN the case of the Montreal Street Railway Co. versus Leboeuf, wherein the latter sued the former for a car not stopping, hailed at a street corner, the Railway Co. were fined nominal damages of $5.00. The plaintiff's other contention that the cars were not run frequently enough as per their contract with the city, was dismissed. The case, however, will no doubt form a precedent for others. It is the first of its kind which has come up.

THE expiry of the main patent of the Bell Telephone Company in the United States, which has just taken place, has been anxiously looked forward to for two or three years past by companies and individuals eager to enter into competition with the company in the manufacture and sale of telephone instruments. In future this competition will be likely to affect the prices of telephones for use in private systems, but otherwise the situation will probably remain almost unchanged, as it has done in Canada, where the Bell patent expired several years ago.

THE General Electric Co., of London, Eng., speak of a style of lighting by inverted arcs which they have introduced into some factories. This system, we believe, has never been tried in this country. The ceiling and walls of the machine shop for instance must of course be whitewashed. The light is thrown on the ceiling by a strong enamel reflector, thus being it is said perfectly diffused throughout the whole shop, the light being good enough for even working at a lathe.

IT may be interesting to some to know that incandescent lamps may be artificially colored by painting them with collodion in which has been dissolved analine dye of any color required, using a camel's hair brush. It is better to have the current on the lamps when they are being painted as the slight heat helps to dry the varnish quickly. These would be useful for decorative purposes during the holiday season but the coloring is not very lasting. Frosting is a more difficult matter, but a fair imitation may be made by dipping the lamp several times into a strong solution of Epsom salts.

IT is said to be the intention of the Dominion Government at the approaching session of Parliament to introduce a measure providing for the inspection of electric meters in the same manner as gas meters. A delegation comprising Mr. C. Berkeley Powell, Standard Electric Co., Geo. T. McDonald, Superintendent of Fire Alarm, J. W. McRae and A. A. Dixon, Chaudiere Electric Light Co., Ottawa; Frederic Nicholls, General Electric Co., Toronto; D. A. Starr, R. A. Ross, Royal Electric Co., Montreal; waited upon the Controller of Customs a few days ago to urge the passing of a measure for this purpose.

THE position of an expert in the eyes of the law appears to be an enviable one. The Niagara Cataract Construction Company refuse to pay the account of $10,000 rendered by Prof. Rowland of Johns Hopkins University, for services in considering and devising plans for the construction of a dynamo of 5,000 h. p. to transmit electric power from Niagara Falls to Buffalo. The company offered to pay $3,500 as the outside value for the services rendered. Thereupon Prof. Rowland amended his account, charging $150 per day for the entire period of service, viz., six months, and secured a verdict for $9,000. Who would not wish to be considered an expert?

OUR contemporary the Electrical Engineer describes at some length a plant installed by Donaldson & McRae, a Baltimore firm, in the Baltimore offices of the Postal Telegraph Cable Co., consisting of storage batteries to take the place of the usual gravity cells. Motor generators, it is true, also dynamos, have done this work perfectly, but we doubt whether the storage battery even for such work is reliable enough. The cells are new ones also, and it would be well to wait the results of several months' tests before taking this as a criterion in other cases. Messrs. Donaldson & McRae claim great things for their new storage battery, and while it may be quite true, yet there have been so many storage batteries rise with the sun only to go down again when it sets, that people may be pardoned for being somewhat skeptical.

A MONTREAL dispatch published in the daily papers last week stated that the Canadian Pacific Railway Company had decided to substitute the electric trolley for locomotives on some divisions of their road through the Rocky Mountains, and that the contract for motors, etc., for this purpose had already been let. As the result of personal enquiries made by our agents in Montreal, the ELECTRICAL NEWS is able to state the facts of the case, which are, that the C. P. R. managers recently sent one of their engineers to the Rocky Mountains to investigate and report on the feasibility of using electricity for this purpose, and he has reported favorably. Should the experiment be tried, it will be watched with world-wide interest by those interested in the possibility of electricity superseding steam for railroad locomotion.

IN a recent issue we referred to the fact that the appeal of the Consumers' Gas Company, the Toronto Electric Light Company and the Incandescent Light Company, of Toronto, against the assessment levied for the first time on their mains, wires, poles, etc., in the streets of Toronto, was being argued before the County Judge, whose decision, being final, would form a precedent for the guidance of other municipalities. The argument has resulted in the case of the Gas Company, in the confirmation of the assessment of half a million dollars on mains and plant. In the case of the Toronto Electric Light Company and the Incandescent Light Company, of Toronto, an agreement was arrived at, under which these companies has consented to an assessment of $50,000 each upon their property. Under a by-law of the city, machinery and plant of manufacturing companies is exempt from taxation except in the case of companies who hold franchises from the city. It was claimed by the assessment commissioner that the electric companies held city franchises and were therefore subject assessment. The companies disputed the correctness of the commissioner's interpretation f the word "Franchise." They contended the word to mean permanent privilege conferred by the city, as distinct from a contract terminable at a stated time. In the absence of any authoritative definition of the word, the compromise above mentioned was agreed upon.

MOONLIGHT SCHEDULE FOR FEBRUARY.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1	P. M. 5.30	A.M. 6.00	12.30
2	" 5.30	" 6.00	12.30
3	" 5.30	" 6.00	1.230
4	" 5 30	" 6.00	12.30
5	" 5.30	" 6.00	12.30
6	" 5.30	" 5.50	12.20
7	" 5.30	" 5.50	12.20
8	" 5.30	" 5.50	12.20
9	" 5.40	" 5.50	12.10
10	" 7.30	" 5.50	10 20
11	" 9.30	" 5.50	8.20
12	" 10.40	" 5.50	7.10
13	" 11.00	" 5.50	6.50
14	" 11.40	....	6.00
15	....	" 5.40	
16	A. M. 1.30	" 5.40	4.10
17	" 3.20	" 5.40	2.20
18	No light.	No light.	....
19	No light.	No light.	....
20	No light.	No light.	....
21	P. M. 5.40	P. M. 8.30	2.50
22	" 5.40	" 9.30	3.50
23	" 5.50	" 10.30	4.40
24	" 6.00	" 11.30	5.30
25	" 6.00	A. M. 1.00	7.00
26	" 6.00	" 1.30	7.30
27	" 6.00	" 2.30	8.30
28	" 6.00	" 3.40	9.40
....	....	....	....
....	....	....	....
....	....	....	....
		Total,	2.0620

SPARKS.

The Lethbridge & Cardstone Telephone Co., Lethbridge, N. W. T., are seeking incorporation.

The Carberry electric light plant, owned by Thomas Oliver, is reported to have been seized by the sheriff.

The Bertram Engine Works Co., Toronto, has been granted provincial incorporation, with a capital of $300,000.

Mr. F. W. Mount, secretary of the electrical department of the St. John, N. B., Gas Company, has patented in the United States a device for securing perfect regulation of automatic engines when run in pairs.

The contract between the city of Hamilton and the Hamilton Electric Light and Power Company will terminate on the first of September next. The city authorities are talking of purchasing the necessary plant to do their own lighting.

The Board of Trade of London, Ont., appointed a committee at a recent meeting to wait on the Council and the Street Railway Company with a view to securing the substitution of electricity for horse power on the street railway of that city.

Mr. F. V. Hedenburg, superintendent of the Canadian General Electric Company's lamp works at Hamilton, was recently made the recipient of a couple of handsome presents from the employees of the factory, expressive of their appreciation of his many admirable qualities.

A convention is said to have taken place at St. Catharines a few days ago between some Buffalo gentlemen and the promoters of the Hamilton, Grimsby and Beamsville Railway, in relation to the scheme for utilizing for electrical purposes the waste power at the DeCew Falls, near St. Catharines.

The Royal Electric Co. is said to be bringing suit against the Montreal Street Railway Company for $27,626.07, the amount of expense to which the plaintiffs allege they have been put by reason of interference with their underground return wires by the placing underground of the Street Railway Company's return wires.

From some correspondence recently appearing in a Halifax paper, there seems to have sprung up a feud between the electric lighting company and the telephone company at Truro, Nova Scotia, as a result of which the former have gone into the telephone business, and the latter are said to be preparing to furnish electric light. Meanwhile the citizens, as usual, are trying to squeeze all they can out of both companies.

Notice is given that application will be made to the Legislative Assembly of British Columbia, at its next session, for an act to incorporate a company for the purpose of acquiring all property, both real and personal, tolls, rights, privileges and franchises of the Vancouver Electric Railway and Light Company, with power to purchase or lease the property and franchises of and amalgamate with any other railway or lighting companies.

Notice is given that application will be made at the next session of the Dominion Parliament for an Act to incorporate "The Niagara Falls Electric Railway Bridge Co.," to build a bridge across the Niagara River at some point between Niagara Falls and the whirlpool rapids, and to operate thereon an electric railway system, with power to connect with the electric railways on both sides of the river.

PERSONAL.

Mr. F. H. Badger. jr., who is well known in Canada from his long connection with the Royal Electric Co., of Montreal, has resigned his position of superintendent of the lighting department, and accepted that of general manager of the Montmorency Electric Power Co., of Quebec. This company is largely increasing the capacity of its system by the erection of a new station to be equipped with new machinery.

NOTES ON THE THOMSON-HOUSTON ARC DYNAMO.*

By James Burnett.

The dynamo used in the Thomson-Houston system of arc lighting is the result of a long series of experimenting, covering a range of years, 1880 to 1885, principally through the efforts of Professor Elihu Thomson, of Philadelphia, Pa., and Lynn, Mass.

The machine as it stands to-day does not bear much resemblance to the earlier types, as from time to time a great amount of labor and painstaking research has been devoted to it; changes in design have been the consequence. The result has been, however, to make it the foremost arc dynamo in the world at the present time.

The efficiency of this machine is about 80% at full load, which at first sight may appear rather low, but in a high tension, open circuit coil dynamo of this type, this apparently low figure occurs from the space required by increased insulation and large amount of wire on the armature and fields. The large diameter of the fields and the opening in the center, necessary to get sufficient periphery speed, partly explain this result. Other reasons are, that the field magnets are of cast iron, of low permeability, where the limit of **B** is soon reached, and as the fields of this dynamo are supersaturated at full load, other causes of inefficiency are explained. Heavy leakage of lines of force, and the fact that the armature is short circuited for a brief period at every revolution, as explained later, all reduce the efficiency figure.

Notwithstanding these apparent discrepancies, the machine is a great success as proved by its enormous sale, competent authorities stating that nearly half the arc lighting in the world is done by this dynamo and the same make of arc lamps. There can be no doubt that these things were amply considered by the designers, and that the machine is the most economical on the market on account of its practibility of operation, and comparative freedom from trouble and repairs. Though of a somewhat complicated design, it only requires a fair amount of attention on the part of the attendant, which I might say is not always accorded it.

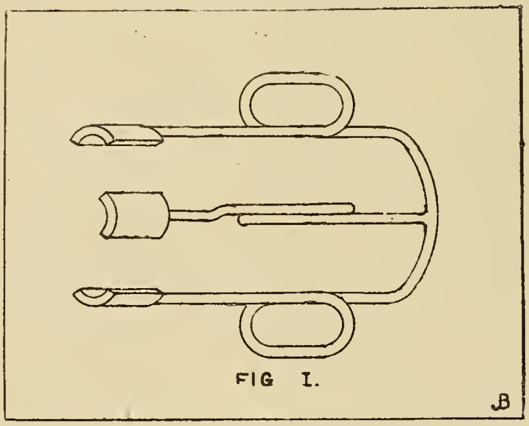


FIG I.

We will now pass on to the principal features of the dynamo, which are: the three-part commutator, the three coil armature, the automatic regulator and the automatic blower.

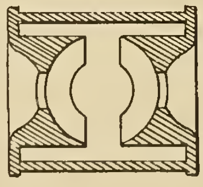
The commutator is of the "air insulated" type, and consists mainly of three segments, with about ¼" gap between each. These are made of extra quality copper. The connections are readily detached, and the segments are numbered to prevent mistakes in connecting up.

The armature is a "sticker" for a novice, and in the older type, the winding is most peculiar—starting from the pulley end from a common junction as shown in Fig. 1, and wound over the laminated iron core and spider longitudinally with the shaft in three main divisions. Each division is approximately 120° apart. The winding is done in such a manner as to make each coil electrically equidistant from the iron core. This is necessary, as at certain positions of the armature, coils are placed in parallel with one another, and injurious heating is thus prevented, which would otherwise ensue. In the latest type of armature manufactured by this company, the winding takes the form of a Gramme ring, rounded on the outside, so as to closely adhere to the cup shaped fields, which are retained. The opposite coils are connected together, of course, and the coils are rectangular in cross-section, being in the M D type, 15 layers deep and 11 wires wide. These are held on in both old and new types, by very heavy and wide binding wires. The ventilation of this ring armature is excellent, and its construction facilitates the repairing of a damaged part.

The machine is series wound as shown in the diagram; a switch is provided for short circuiting the armature, when we want to shut down the dynamo. This is a better way than opening the circuit at the wall switch, as by doing this, the sudden discharge from the fields may perforate the insulation and spoil the machine. The Royal Electric Company provide another switch which is very serviceable. It short circuits a certain number of layers of the winding on one field, and thus increases the range of the regulator. The functions of the blower are needed when the slanting brushes, characteristic of this dynamo, short circuit an active coil. When this occurs, a knife-like blast of cold air is delivered at the gap where the arc is established, the result being the rupture of the arc.

FIG. 2

SECTION OF FIELD



The automatic regulator is the very soul of this system, and to it, to a great extent, the success of the Thomson-Houston system of arc lighting is due. A reference to the diagram will show its operation. Its functions may be described as raising or lowering the electro-motive force, at the terminals of the dynamo, in response to increases or otherwise in the number of lamps on the circuit, or of changes in the length, and consequent resistance of the arcs. When lamps are thrown off, by being short-circuited, as is usually the case, the current (normally 6.6 amperes for a 1200 candle power lamp and 9.5 amperes for a 2000 candle power lamp) becomes excessive, and the solenoid B (see diagram,) raises. This opens the silver-mounted switch, and the bulk of the current passes through the powerful controlling magnet. This magnet with paraboloidally shaped end, attracts a cast iron armature below it, and by means of an elaborate set of chain work, it moves the 4 brushes set tangentially to the face of the commutator. The two "leading" (top) brushes are moved about three times as fast as the two "following" (side) brushes. The result of this is that the most active coil on the armature is sooner cut out of action, and put in parallel with a weaker one. To prevent flickering of the lights, a dash-pot filled with glycerine, is used to dampen the regulator's movements. A carbon shunt E, of about the same resistance as the magnet referred to, is inserted in the switch to prevent injurious sparking when the switch is opened.

FIG 3

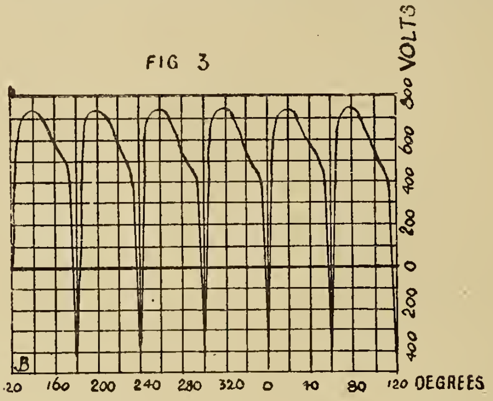


Diagram 3 shows the behavior of the current during one revolution of the armature. It will be noticed that the lines fall below zero six times during each revolution. (This is at full load on a 10 light 1200 candle power dynamo). This "dip" is the result of the short circuit caused by the arc, at the commutator, as before mentioned. The polarity of the field magnets is then reversed to a certain extent, for only a short period of time, which time depends a great deal, of course, on the conductivity of the arc and the strength and effectiveness of the air blast. This is probably the reason this machine will not run separately excited. No injurious effects occur from this reversal, as by looking at the diagram No. 3 it will be seen that the area of the space enclosed by the dip is practically *nil*. The steadying power of the large masses of cast iron in the fields of a series dynamo, giving intermittent or fluctuating currents, is well known. Curves have been plotted, comparing current with potential, showing a remarkable similarity, which is attributed to these large fields.

Diagram 2 illustrates a section of this field.

I think that a few remarks as to the running of this plant may not be astray. The construction and theory of this dynamo should be well understood by the person in charge. Much trouble will be avoided by this, and if trouble should happen, it can be at once remedied. On starting up, the regulator lever should be first raised. No injurious effects can then ensue if a short circuit happen to be upon the line, as the brushes are collecting at a period of minimum activity. Grounds should be carefully avoided and frequently tested for. The dashpot should not be allowed to get too stiff in its action, as when lamps are turned off either at the switch-board or on the line, an excess of current will flow for a while till the regulator reduces it. On an ordinary arc circuit no bad effect would result, but on a line with distributor boxes, and incandescent lamps in series-parallel, the lamps are liable to be destroyed. A little alcohol added to the glycerine usually has the desired effect.

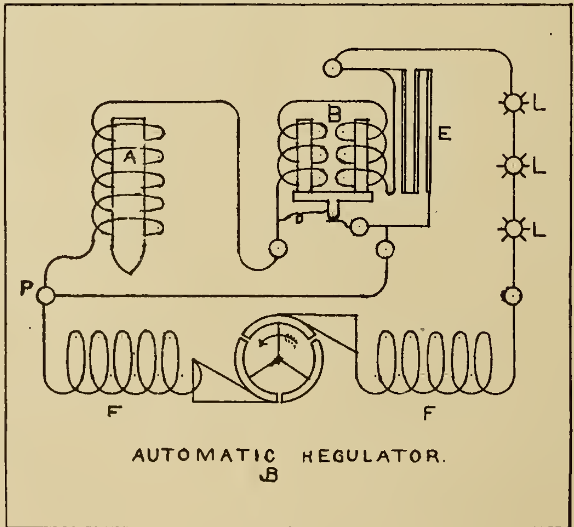


Fig. 4.

Flashing at the commutator is often a source of trouble, on this dynamo, and may occur from a variety of causes, such as a large and sudden variation of speed, the commutator not being set aright at the start, or a blower out of order. These are the most frequent causes. A wing may not work freely or is worn unevenly, and possibly the air jet is not directed to the right point. A slight shifting of the commutator may remedy it, but this of course is supposed to be set aright in the factory before shipping, and not to be changed after then. It should be borne in mind that shifting the com-

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* Paper read before the Montreal Electric Club.

mutator not has the same effect as raising the regulator. In the first case the brushes have the same relation to each other, and in the latter they do not. When brushes are put on the dynamo, they should be set exactly to guage, viz., 4¼ inches from the holder. After using for some time, the segments invariably have a hollow near the gap, which is often a source of trouble, through the brushes being too springy; an easy and practical remedy is to insert a piece of cotton waste underneath the holder and over the brush, wedged in tightly.

The three lead wires which come through the shaft from the armature have different colored braided coverings, viz., red, white and blue, which go to segments marked 1, 2, 3, respectively. Care must be taken to return them to their proper places, as results will be had that were not thought of by the designers. Loose contacts should be guarded against, and though broadly speaking, contacts on an arc circuit do not require much carrying capacity, there are one or two which should be guarded against. One is the triple binding post at the end of the field, marked P on the diagram. Any resistance interposed here, has the result of cutting out the large magnet, and the regulator may not work from this cause. The carbon shunts may also be damaged.

Only the best mineral oil should be used, especially in the blower, where thin oil must be used. The gauze wire in the inlet of the blower, should be frequently cleaned from impurities.

In conclusion—*a careful study of this dynamo will repay itself.*

QUESTIONS AND ANSWERS.

A correspondent asks:—

1. What proportion should the piston rod of an engine be to the piston?

ANSWER.—The problem is one upon which there are differences of opinion. A little consideration will show the difficulty. The load is on the piston, and the resistance is at the cross-head, hence the *length* should be taken into account. Then it is not enough that the rod will not *break*, but it must not *bend* at all, for if it does it will spoil the packing at the cylinder gland, increase friction, and do other mischief. The material of which the rod is made is subjected at one time to a pulling strain and the next instant to a compressing one. The following, is however, a good safe rule for diameter of piston rod:—For a wrought iron rod, multiply the diameter of the cylinder in inches by .018 and by the square root of the highest steam pressure. Example:—The cylinder is 30 inches in diameter, and the boiler pressure 100 lbs.—what should be the diameter of a wrought iron piston rod and of a steel one? By the rule, multiply 30 by .018 and by the square root of 100.—$30 \times .018 \times 10 = 5.4$ ins. diameter. For steel, instead of .018, use the figures .012—$30 \times .012 \times 10 = 3.6$ inches, for a steel rod.

2. What rule can I go by to plan out the crank pin and cross-head pin of an engine?

ANSWER.—The crank pin in a single crank is like a beam fixed in the one end and the load uniformly distributed, or it may all come on outer end. It must, however, be sufficiently rigid not to bend in the slightest degree. The following is a safe rule, and will give rather larger sizes than are usually found, but as steam pressures and speed of engine are increasing, it will be found necessary to increase size of crank pin:—For diameter of pin, multiply diameter of cylinder by .02 and by square root of highest steam pressure. Example:—For 30-inch cylinder with steam at 100 pounds pressure, what diameter should the crank pin be? $30 \times .02 \times 10 = 6$ inches. The length may be varied from about same as diameter to one and a half times diameter, but the diameter and length should be checked by the following method:—The total pressure on the pin must not force out the oil, and to ensure this, the pressure must not exceed 1200 lbs. per sq. inch of surface. In the example, a 30 inch cylinder with 100 lbs. per sq. inch on piston will exert a pressure of 70,686 pounds on the crank pin, and that the pressure shall not exceed 1200 pounds per sq. inch, 70,686 divided by 1200, gives 67.—That is, the diameter of crank pin multiplied by its length, should give 67. If the crank pin be made 6-inch diameter, then its length should be 10¾ inches. It would be better, however, to increase the diameter to say 7½ inches, and make the length 9 inches. The cross head pin may be smaller than the crank pin, as it is usually supported on both sides, and as the motion is so much less, the oil is not so ready to be forced out.

3. What amount of surface of the cross head should be in contact with the guides?

ANSWER.—The principle here is, that the pressure on the guides should not force out the oil. The pressure on the guides varies with the proportionate length of connecting rod, to crank. Short connecting rods throw a heavier pressure on the guides than long ones. The pressure may be estimated to vary from one fourth to one eighth of the total pressure on the piston when at the middle of its stroke. To find the area of sliding surface, multiply the area of cylinder by the average steam pressure, on piston, and divide by four. That will give the total pressure on the sliding surface; then by allowing about 100 lbs. per sq. inch as a suitable pressure, the area is just one hundredth part of the total pressure. In some locomotives the slides are so large that the pressure amounts to only 40 lbs. per sq. inch. The larger the surface, the less wear there will be.

In the December number of the ELECTRICAL NEWS, Mr. Joseph Ogle, of Brantford, Ont., gave a description of the heating system in use in the factory in which he is employed as engineer, and asked for an expression of our opinion as to certain proposed improvements. Our reply to Mr. Ogle's inquiries was also published in our December number. We have since received the following letter from him on the subject: Enclosed you will find a rough sketch of our heating system. Since I wrote you, you will notice we have changed the 4 in. header to a 6 in.; we had also the header tapped on both sides with the five 1¼ in. pipes, leading around the factory to the opposite side, these each having a separate 2 in. drip but only for a few feet where they are connected and lead the remainder of the way through one 2 in. pipe. Will you kindly express your opinion on the change. If you would suggest any further change, kindly explain fully the reasons for the same, if any.

ANSWER.—Mr. Ogle has not yet carried out quite correctly our former suggestions. 1. One 6 in. header supplies the two coils. A separate header to each would have been better and would have enabled him to control the amount of steam going to each.

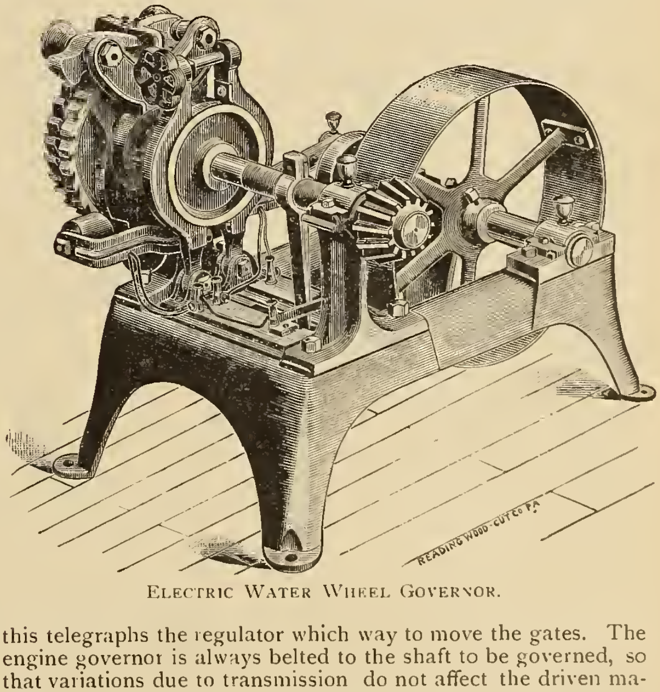
2. The returns should not be joined together, but should be dropped down as vertically as possible.

3. The returns should not discharge into the heater, but may be led into a *low* tank from which the water may be lifted.

4. There should not be a rising pipe from the return, open to the air. In a well proportioned exhaust steam heating coil, there will be at times, a partial vacuum, that is, the pressure inside the coil will be below atmospheric pressure. Hence to get the water discharge from the coil, the return pipe must be led down, so that the weight of water may overcome the resistance offered to the discharge by the difference in pressure. For the same reason all connection between the atmosphere and the return pipe should be avoided, and the return from each coil should discharge under water. There should be a valve at the steam header end of coil, so that when engine is stopped, by the opening of this valve air may be admitted to the coil, to make sure that all the water will be discharged before the temperature falls low enough to freeze up the coil. The pipes should have a good fall from the steam end to the discharge end.

ELECTRIC WATER WHEEL REGULATOR.

The accompanying illustration represents an electric device for controlling the speed of water wheels. The device consists of a regulator, a high-speed engine governor, and a gravity battery with its circuit. The regulator is strong enough to control the gates of water-wheel, and receives its power directly from the wheel. It is also so sensitive that the battery current will cause it to act upon the gates. The engine governor is simply used as an indicator, and as the pointer rises or falls with the slightest variations of speed, it touches a contact point, and this telegraphs the regulator which way to move the gates. The engine governor is always belted to the shaft to be governed, so that variations due to transmission do not affect the driven machinery. There is no limit to the distance that may be between engine governor and the regulator. It is claimed that by means of switches, perfect control of wheel can be had from any point in or out of plant or factory.


READING WOOD-CUT CO. PA.

ELECTRIC WATER WHEEL GOVERNOR.

Messrs. Wm. Kennedy & Sons, of Owen Sound, Ont., who are the manufacturers and vendors of this device in Canada, in answer to our enquiries concerning it, write: "We have been watching the record of these governors for the last two or three years and feel sure that they have no equal as a water-wheel regulator, hence the reason for our taking hold of them. For electric work, we feel sure that they will give satisfaction and greatly improve the service when the motive power is water. We give thirty days' trial of the machines when they are placed by us before they are taken off our hands as a guarantee that they will do the work. We are fitting one to the water-wheel of the power house plant which we have almost completed at the Canadian Soo."

ENGINES FOR ELECTRICAL WORK.

AMHERST, N. S., January 26th, 1894.

Editor CANADIAN ELECTRICAL NEWS.

DEAR SIR,—Mr. J. H. Killey, in his letter published in your January number, thinks he may be expected to give an unbiased opinion of what has come under his observation in regard to high speed vs. slow speed engines. I hope no one will doubt the sincerity of the statements expressed by any of those who have ventured to state their views through your valuable columns on this important subject, but it is possible that any or all of us may not have had so wide experience with the various classes of engines as would enable us to decide this question positively of our own knowledge. For my own part, although I have had a somewhat varied experience, and could name many instances of good and bad performances of both slow and high speed engines, I would feel unwilling to express an opinion based entirely on my own experience; and although I have no doubt Mr. Killey's experience, as he states, has been unfavorable to the high speed engine, I feel sure he has not had an opportunity of observing or testing the best engines of this type. The statement he makes in regard to the high speed engine taking 4½ lbs. of coal per I. H. P. per hour shows that he has not, because it is a well known fact that high speed engines are in use that develop an I. H. P. with 15 lbs. of water per hour, which, with ah evaporation of 10 lbs. of water per pound of coal, would give 1.5 lbs. of coal per I. H. P. per hour, and it is a common practice in the United States to guarantee 20 lbs. of water per I. H. P. per hour for high speed compound engines. I have no doubt there are simple high speed engines of small size using 4½ lbs. of coal per I. H. P. per hour, or even more, if they are overloaded or as badly constructed as some I have seen, and I know of long stroke engines which are not doing any better, but it is not fair to compare them with a compound condensing engine of about 200 H. P. such as Mr. Killey reports as having a consumption of rather less than 1¾ lbs. of coal per I. H. P. per hour. (By the way, I make it 1.77 lbs. which is rather more than 1¾). However, the result is remarkably good, and if the engine will do this duty under the usual conditions of street railway work the owners of the plant should be more than satisfied. There are two features of Mr. Killey's report, however, which show an error somewhere. He says "the test of the engine extended over ten hours, *88 diagrams having been taken during its continuance* showing a large and immediate change in the power as the work came on and off it, varying from 80 to 230 H. P., *yet not the slightest variation could be detected in its speed from a friction load with current switched off, or the whole load of say 230 H. P.*" (The italics are mine).

1st. It is a well known fact that the centrifugal governor, which is used in various forms for all steam engines, depends for its regulation upon a variation of speed, and it is not possible to have such a governor operate without some variation of speed in proportion to the amount of load on the engine. The best high speed engines regulate with a variation of 2 to 3 per cent. from no load to full load, and supposing that a long stroke engine may regulate with no more variation than the amount stated from no load to full load, this only takes into account the average speed during one minute as compared with the average speed during another minute, while the variations may be, and always are, very much greater during shorter periods when the fluctuations of load are sudden, as they are in street railway work, the load going off and on in an instant; a slow speed Corliss engine makes only about one revolution in a second, and if the load comes on after the cut-off has taken place there is no opportunity to regulate until the begining of the next stroke. Even after a change of cut-off has taken place, particularly if the engine is compound, it will take several strokes before the necessary change in pressure can reach the low pressure cylinder and the engine be brought to its normal rate of revolution.

2nd. 88 diagrams were taken in ten hours, which, if they were single diagrams, would be 22 sets from both ends of high and low pressure cylinders, or only one complete indication every 27 minutes; or even if 88 sets were taken it would only be one set for every 7 minutes. In either case, with a load varying suddenly between wide extremes, there is room for a considerable error in horse power, which in connection with the apparent failure to note the variations in speed, may have caused a still greater error in the horse power upon which the economy is based.

Engineers who have attempted to make tests of engines doing street railway work realize the difficulty of getting a true average of the work done except by means of recording watt meters, giving the total electrical horse power, or almost continuous indications of the engines, and with very sensitive tackometers or continuous revolution counters to indicate the speed.

Mr. Killey states in closing that "the whole tendency of electrical engineering at the present day is towards larger machines and slower speeds." Charles E. Emery, Ph. D., in a recent article entitled "Lessons of the Columbian Year," published in Cassier's Magazine, says "it is probable that this type (referring to the Corliss engine) will be a permanent one for engines of moderate speed, say 100 revolutions or under, although the speed of this type of engine is being constantly increased." He also refers to the pleasing display of so many high speed engines at the World's Fair, "all apparently operating well without the difficulties of heated bearings which used to be incident to this class of engine, and many of them regulating with an accuracy that is as surprising as it is gratifying." Dr. Emery is, I believe, considered one of America's foremost engineers, and has had a wider experience and more opportunities of observing the performance of engines under all circumstances than almost any man in the engineering profession. I have, in my previous letter, quoted from his report on the cost of producing a horse power by various classes of engines, showing that the high speed engine will, under certain circumstances, produce a horse power cheaper, including cost of repairs and maintenance, than a slow speed engine. I have also quoted from a report by three of the leading electrical engineers of the United States, Messrs. Connette, McIntyre and Pearson, positively recommending high speed engines for small plants. In addition I would refer you to the report of a test of three large street railway plants at Minneapolis and St. Paul. Two of these were driven by low speed triple expansion condensing engines of large size, the average horse power of each engine being from 418 to 705; the third plant was driven by high speed compound non-condensing engines, the average horse power of ten engines being 522. The tests were made by Messrs. William A. Pike and T. W. Hugo, members of the American Society of Mechanical Engineers, and Mr. Aid Collins, Agent of the Hartford Boiler Insurance Co., at the instance of the Twin City Rapid Transit Co., for the information of the company who owned them. No pains or expense were spared to make the test complete and accurate in every particular. The report is embodied in a paper presented to the American Society of Mechanical Engineers, and may be found in their transactions. These tests show that the total cost of power per car mile by the slow speed triple expansion condensing engines is only about 3 per cent. better than the total cost of power per car mile by the high speed compound non-condensing engines, and the experts report that if the high speed engines had been furnished with the proper pressure of steam they would have done about 1½ per cent. better than the long stroke engines. The same report shows that, while the variation in speed of the high speed engines was never more than 5 per cent., the long stroke engines varied at times over 40 per cent. In regard to speed, the report reads as follows: "Another matter which cannot help affecting economy, is the very rapid regulation of the smaller engines, thus adapting themselves more readily to the variations in load than is possible with engines of the Corliss type. In a regulation test, October 26th, 1892, it was found that the governors on the Westinghouse engines were able to change from a very heavy load to a mere friction load within four revolutions, or one second of time." While this test furnishes conclusive proof that high speed engines, not of the highest type, are better adapted to the peculiar conditions of street railway work than the highest grade of long stroke engines, I do not think it detracts, in the slightest degree, from the value of the long stroke engines for certain other circumstances to which they are adapted.

Now, Mr. Editor, although you seem to think, as stated in your last issue, that "the preponderance of opinion so far was in favor of low speed," (I suppose you meant as expressed through your columns), I think you will admit that there is quite weighty evidence that the high speed engine is better adapted to electric railway work, especially for small plants, and I think I may safely add that I believe every consulting engineer, either mechanical or electrical, who has had extensive experience with street railway plants in the United States will agree, in the main, with my statements; and in Canada I think there are a large number of practical engineers who, like the Power House Engineer quoted in your last issue, would stick up for high speed for railway work. In regard to the two correspondents who oppose me, I cannot but think they misunderstood my intention and took my remarks as a reflection on the low speed engine, or an attempt to claim superiority for the high speed eengine, in a genral sense, but I hope I have made it clear that such was not my aim, but rather to show how and where each class has advantages.

Yours truly,

D. W. ROBB.

ENGINES FOR ELECTRICAL WORK.

Editor ELECTRICAL NEWS.

PETERBORO', ONT., 3rd January, 1894.

DEAR SIR,—I have been much interested lately in the correspondence on the above subject, appearing in your paper from time to time, being at present deeply engaged in the study of the various forms of slow and high speed engines now upon the market. As a designer of steam plants, I feel that I should like to take a part in the discussion upon the subject, as there are many things pro and con that I must necessarily keep in mind.

Upon the above subject I reason with myself thus: that concentration of power in a small space is the feature much sought after in the steam engine,—in fact, it is its power to concentrate the strength of thousands of horse power in the space of an ordinary room that renders the steam engine so useful and indispensable to us. Because of this we cannot go on increasing the volume of the engine without a proportionate increase in power, and that cylinder whose stroke equals its diameter contains the maximum of volume, with the minimum of condensation.

The reduction of condensation surface is being more and more sought after by engineers, and is thoroughly appreciated by them, and just so soon as we become better acquainted with the laws of inertia, the shortening of the stroke or constructing the engine cylinders square or nearly so, that, together with the high speed of the reciprocating parts of the engine, will prove a less terrifying object than hitherto to engineers. And yet there is no more unsafe proceeding in engineering science than to attempt to predict the limitations of the development of the steam engine. It is in the utilization of the steam after it reaches the engine that we must hope for improvement—diminution of condensating surface, shortening the duration of time for condensation, which means of course an increase in the number of strokes. By a study of the laws of condensation we are led to the conclusion that a squared cylinder should be the controlling consideration. That the fast speed should have any effect upon the structure of the steam engine cannot I think be fairly argued to-day, for where there is a clear knowledge of the dynamics of the steam engine, the defects of a faulty designed structure will not be present. High speed necessitates increased length of crank pin and shaft bearings; the diameter of all bearings should be as small as the pressures allowable upon the contact surfaces will admit. The co-efficient of friction is much affected and reduced by the state of the rubbing surfaces; the method of lubrication and the lubricant used requires consideration. The design of the connecting rod requires that it be larger in cross sectional area atthe crank pin end, than at the cross-head end.

The long stroke engine is not as desirable as the short stroke for incandescent lighting, for by a careful observation of the lamps you can count with great precision the revolutions made by a long stroke engine, the effect of which upon the films of the lamps is most injurious. For example, we have a slow speed engine making sixty revolutions per minute; the dynamo runs 1,500; one revolution decrease in the speed of the engine would mean 25 on the dynamo. With a high speed engine running 250 revolutions per minute, one revolution decrease would only be 6 on the dynamo. The visible effect then upon a high speed engine if run at or nearly at its regular speed would be very little. By necessity the short stroke requires that a much greater attention be paid to any increase of the revolutions than in the slow speed in proportion as the stroke is shorter. The same factor of an increase of speed from the commencement to the middle of the stroke and the decrease of the speed from the middle to the end of the stroke, is present in the short stroke as in the long stroke engine, but it becomes less in percentage as the stroke is shortened and becomes more frequent. Regular speed does not mean a great variation, but a close approximation to a certain line; any variation from this is noticeable.

I have said nothing regarding clearance, port area, pipe area,

&c., and methods of constructing the engine, but may do so with your permission at a later day.

I remain, yours truly,
AL. C. MCCALLUM, M. E.

ECONOMICAL FIRING.

PORT CREDIT, ONT., Jan. 19, 1894.

Editor ELECTRICAL NEWS.

SIR,—I have noticed in engineering papers the writings of men who say that a good fireman can save money to his employer and a poor one can waste it, but they stop right there without giving any directions or methods by means of which we firemen can improve ourselves. I would like to learn the methods that other firemen adopt in order to keep up steam and save coal. I will give mine, and would like more experienced men to tell me where I can improve.

I am firing two horizontal tubular boilers, rated about 75 horse power each, and there is so much steam used that if I lose 5 lbs. pressure it takes 45 minutes to get it back again. I use screenings, and carry my fires about 7 inches thick all over the grates, which are stationary ones.

I stir all my fires, then put coal on one side of each furnace; in four minutes I stir all my fires again and put coal on the other side; and so on every four minutes, gauging the amount that I put in by the thickness of my fires. My reason for firing alternate sides is: when I have a white hot fire on one side and fire new coal on the other side, the smoke rolls over and some of it at least gets consumed. If I neglect doing the stirring, the pressure goes down immediately. I have what experienced engineers consider to be good draught.

R. B.

[Our correspondents method of firing slack coal is a good one. The only point to which we would call attention is the thickness of the fire. He says he keeps it *seven* inches thick, and if he neglects to stir it down goes the pressure. This seems to point to the fire being too thick for the strength of draught, and that sufficient air to maintain good combustion does not get through the coal till he breaks it up. The *thinner* the fire can be kept, the more effective will the combustion be, and the thickness which will give best results depends largely upon the strength of draught. We would suggest to try a thickness not *exceeding* five inches, or even less, and let our readers know the result. If he has to fire up at intervals of four minutes, he may not have sufficient boiler capacity for the steam required to use such a class of fuel. However, we would like him to experiment with *thin* fires, and let us know the result.—Editor ELECTRICAL NEWS.]

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of the various Associations are requested to forward us matter for publication in this Department not later than the 20th of each month.

OTTAWA ASSOCIATION NO. 7.

Editor ELECTRICAL NEWS.

SIR,—The last regular meeting, in December, of Ottawa No. 7 was held with Bro. J. H. Thompson in the chair. On that evening engineering questions did not receive much attention, as the most important business was the election of officers for 1894. Those who have been chosen are: President, Frank Robert, (Russell House); Vice-President, Mr. H. Graham; Rec. Secretary, J. A. B. Latour, (41 Bolton St); Fin. Secretary, Albert Cane; Treasurer, Wm .Hill; Conductor, John Harris; Doorkeeper, Charles Schofield; Trustees, J. D. Thompson, M. J. Campbell, Frank Merrill.

After some appropriate remarks from the past President and the newly elected officers, Bro. Robert presented the Association with a model of a plain slide valve engine, donated by the engineering supply firm of McKinley & Northwood, which was highly appreciated, as it will be a valuable addition to our educational department.

At the first meeting in January, the time of the meeting was very much taken up with routine business, including the installation of officers, so as to leave very little time for discussion on engineering, but as the meeting was about to be closed, an inquisitive member thought he could not rest at ease if he went home without knowing on what principle the Osborne-Killey engine governor worked, when some one having had experience with that class of engine explained the office of the weights and springs attached to the fly-wheel, at the same time making a sketch to show that it consisted of a sleeve carrying an eccentric, revolving on the engine shaft, driving an auxiliary valve over the main valve, the latter being driven by a fixed eccentric. When the weights fly out against the opposing force of the springs, which takes place when the speed of the engine increases, the auxiliary eccentric is pulled ahead, and cuts the steam off at such a point as is required to regulate the engine's speed according to the variation of load.

After the details of the governor were explained Bro. Latour at the request of the President said that the subject of his paper to be read at next regular meeting would be "The Practical Applications of the Steam Indicator." And as the application of an indicator to an engine is a scientific experiment it will be undertaken with a certain degree of precaution, for the value of a diagram depends on its correctness, and the value of the indicator is so generally recognized by engineers that we expect a full attendance at the next meeting.

Our educational work has been carried on satisfactorily so far, judging by the remarks of the majority of members. It is very encouraging to hear one saying that since he joined the Association he gained information that is worth more than all the contributions payable in twenty years; it shows that engineers are realizing that to attain a high position in their profession, and command the highest standard of wages and also to be a good, reliable, and economical engineer, it is absolutely necessary to be familiar with at least the ordinary rules of arithmetic. Sometimes engineers are very much embarrassed when confronted with the mathematics of steam engineering, but to obviate that difficulty we have adopted a course of instruction so simplified as to be within the comprehension of every one with ordinary education; and no matter how simple it may appear to those who are fortunate enough to be familiar with the higher branches of mathematics, there is always a marked interest taken, and the educational matter receives their earnest attention. It is by such good work that we will strike the point we are aiming at, and every engineer should be encouraged by thinking of the advantages at his disposal, for it is well known that any one who belongs to an association has at his back the combined ability of all the members of that particular association, and he should depend upon it at all times, for the reason that a true and broad minded engineer will never refuse to impart the benefits of his past experience to his fellow engineer. By keeping this in view we cannot fail to make the C. A. S. E. the grandest organization of Canada.

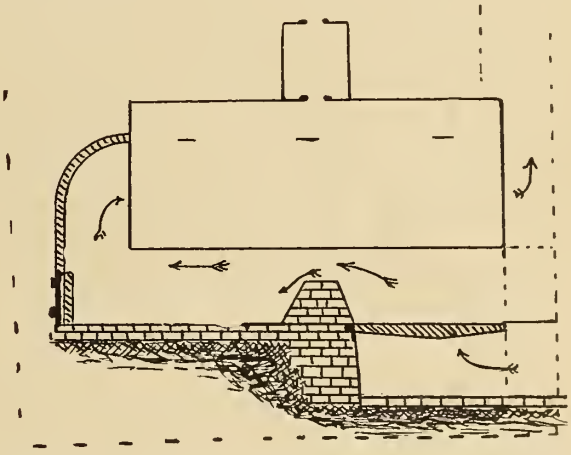
As we are entering a new year with encouraging prospects, it affords me great pleasure to extend to all the branches of the C. A. S. E., the best wishes of Ottawa No. 7.

"PROGRESS."

HAMILTON ASSOCIATION NO. 2.

At the instruction meeting held on the evening of January 19th, Bro. Joseph Langdon gave a very practical and interesting address on the subject of "Boiler Setting." He pointed out the advantages which the new type of boilers possess over the old, and opened the way for a full discussion of the subject by the brethren. The majority of opinions expressed were favorable to an open space being allowed back of bridge wall, a full 20 per cent. more area between bridge wall and bottom of boiler and following the circle of the boiler shell, and that the best results are obtainable when the grate bars are from 24 inches to 30 inches from shell of boiler.

Bro. Stott made the following sketch of the boilers of which he has charge:



The members of this Association would be pleased if other Associations would take up the discussion on this subject, and give the result of their deliberations through the ELECTRICAL NEWS.

WM. NORRIS,
Rec. Sec'y.

The following description is given of a loud speaking telephone recently devised by Mr. Graham, of the Electric Wire and Fittings Co., Westminster, B. C.: He has succeeded not so much by an improvement on the existing telephones, although some modification of the apparatus has been affected, as by his method of arranging the circuit and bringing its resistance as low as possible. To this end the usual induction coil is discarded, and the two instruments, transmitter and receiver, are directly connected in circuit with the line and the battery. The transmitter of A at one end of the line is connected to the receiver of B at the other end. As this arrangement only permits of A speaking to B, and not of B replying to A without a change of the connections and a substitution of apparatus, two separate lines are employed, having a common return wire. On the second line the transmitter of B is directly connected to the receiver of A. The two correspondents can thus talk quite freely with each other, and as the receivers speak out so as to be heard in any part of a room, conversation can be carried on by each person simply speaking to his transmitter. This apparatus is attached to flexible conductors and is held in the hand. To open a conversation it is sufficient to pick up the portable transmitter and press a button in its casing so as to establish the circuit, then speak into it. The receiver at the other end acts as its own call-bell by the loudness of its voice, and the response comes equally prompt and loud. The user has, therefore, no need to listen carefully with one or two receivers held up to his head. All he has to do is to speak into his transmitter and keep his ears open.

THE PHILOSOPHY, APPLICATION, CONSTRUCTION AND IMPROVEMENT OF THE STEAM ENGINE.*

SECOND PAPER—BY JOHN C. GOUGH.

I have much pleasure in reading before your club, to-night, the continuation of our paper on the above subject. We have already endeavored to partly trace that incalculable store of potential energy (the heat and light of the sun), upon which the human race is so dependent, until it is partly expended in doing work through its medium the steam engine, and it may be well that we dwell upon this subject until we are quite familiar with it, as it will be of the greatest assistance to us in laying claim to discuss and explain the construction and improvement of that great prime-mover in which we are so much interested to-day. It will, no doubt, make it much easier for us to discover what principles are comprehended in its philosophy, to learn what are known facts bearing upon its operation, and to determine what are the directions in which improvement must take place, what are the limits beyond which improvement cannot possibly be carried, and in some directions, to determine what is the proper course to pursue in effecting improvements. The general direction of change in the past, as well as at present, is easily seen. We may therefore form an idea, based upon experience of the probable direction in which to look for improvement in the near future.

Reviewing the operations which go on in this prime mover, the steam engine, during the process of transformation of energy which has been outlined, and studying it more in detail, we may deduce the principles which govern its design and construction, guide us in its management and determine its efficiency. I will, however, finish the heat question in boiler and furnace pit. In the furnace of the boiler, the quantity of the heat developed in available form is proportional to the amount of fuel burned. It is available in proportion to the temperature attained by the products of combustion ; were this temperature no higher than the temperature of the boiler, the heat would all pass off unutilized. But the temperature produced by a given quantity of heat, measured in heat units, is greater as the volume of gas heated is less. It follows therefore, that at this point, the fuel should be consumed with the least possible air supply, and the least possible abstraction of heat before combustion is complete. High temperature of furnace is also favorable to complete combustion, (hence the great saving in fuel where mechanical stokers are in use.)

We might therefore conclude that, in the steam boiler furnace fuel should be burned in a chamber having non-conducting walls, and with the smallest air supply compatible with thorough combustion, and further, that the air should be free from moisture, that greatest of all absorbents of heat, and that the products of combustion should be removed from the furnace before beginning to drain their heat into the boiler. A fire-brick furnace, a large combustion chamber with thorough intermixture of gases within it, and a restricted and carefully distributed supply of air, are the conditions which meet these requisites best. The heat generated by combustion traverses the plates which separate the gases of the furnace from the steam and water confined within the boiler, and is then taken up by those fluids, raising their temperature from that of the entering feed water to that due the steam pressure, and expanding the liquid into steam occupying a greatly increased volume, thus doing a certain amount of work, besides increasing temperature. The extent to which heat may be thus usefully withdrawn from the furnace gases depends upon the conductivity of the boiler plates, the rate at which the water will take the heat from the metal, and the difference of temperature on the two sides of the metal. Extended heating surface, a metal of high conducting power, and a maximum difference of temperature on the two sides of the separating plate, are the essential conditions of economy.

The heating surface is sometimes made of so great an area that the temperature of the escaping gases is too low to give good chimney draught, and a mechanical draught is resorted to such as fan-blowers and steam-blowers (the latter, however, I cannot say that I would recommend), being ordinarily used for its production. In my experience, I must say I have found it an economical method to adopt. The steam boiler, nowadays, is generally constructed of steel, sometimes, but rarely, of iron ; the steel, however, is found to be the better in consequence of its greater strength, its homogeneousness of structure, and its better conductivity.

The maximum conductivity of flow of heat for any given material is secured by so designing the boiler as to secure rapid, steady and complete circulation of the water within it. The maximum rapidity of transfer throughout the whole area of heating surface is secured, usually, by taking the feed-water into the boiler as nearly as possible at the point where the gases are discharged into the chimney flue, withdrawing the steam near the point of maximum temperature of flues, and securing opposite directions of flow for the gases on the one side and the water on the other. Losses of heat from the boiler, by conduction and radiation to surrounding bodies, should be checked as much as possible. Of the coal burned in a steam boiler, it rarely happens that more than three-fourths is utilized in making steam the remainder being in ashes, clinkers and moisture, therefore the engine does not get the number of foot pounds per pound of coal burned in the steam boiler as the casual observer might be led to suppose.

Now, the steam in the engine first drives the piston some distance before the induction or steam port is closed, and it then expands, doing work, and condensing in proportion to the work done as the expansion proceeds, until it is finally released by the opening of the exhaust or eduction port. Saturated steam is modified in its action by a process to which we referred in our last paper, condensing at the beginning and re-evaporating during expansion and at the end of the stroke, thus carrying into the condenser considerable quantities of heat, which should have been utilized in the development of power. Whether this operation takes place in one cylinder or in several is only of importance in so far as it modifies the losses due to conduction and radiation of heat, to condensation and re-evaporation of steam, and to the friction of the parts of the engine.

This re-evaporation is counteracted to an extent by steam jacketing, and I believe was one of James Watt's improvements (?). It is a casing around the cylinder, this being filled with steam, and in communication with the boiler, which supplies, as it were, a reservoir of heat which would, by raising the temperature of the expanding steam in the cylinder, retard the condensation therein due to the loss of heat consequent on expansion ; but in parting with heat thus to the steam within the cylinder a portion of that in the steam jacket is condensed, hence it is very questionable if any economy of fuel ultimately results from the adoption of the steam jacket. In all cases, however, the cylinder whether jacketed or not, should be surrounded by lagging, viz., a layer of some material which is a very slow conductor of heat, until something more suitable can be adopted, to prevent loss by radiation, etc.

The loss due to condensation, however, on the cooled interior surface of the cylinder at the commencement of the stroke and the subsequent re-evaporation as expansion progresses, is least when the cylinder is kept hot by its steam jacket, and when least time is given during the stroke for this transfer of heat between the metal and the vapor.

It may be said that, all things considered, therefore, losses of heat in the steam cylinder are least when the steam enters dry, and I venture to say, moderately superheated, where the interior surfaces are kept hottest by the steam jacket, and the piston speed moderately high.

The mechanical power which has now been communicated to the machinery of the engine by the transfer of the knetic energy of the hot steam to the piston is finally usefully applied to whatever mechanism of transmission forms the connection with the machinery driven by the engine. In this transfer, we find, there is some loss in the engine itself by the friction of its rotative and reciprocative parts. This is a variable amount, nowadays, and can be made very small by skilful design and good workmanship and management. It may be taken at ½ lb. per sq. inch of piston for engines of good design and workmanship, of say, 100 h. p. and upward, but is often several pounds in very small engines. It is least where the rubbing surfaces are of different materials, but both of smooth, hard, close grained metal, well lubricated with the best lubricants, and where advantage is taken of any arrangement of parts which permits the equilibration of pressure, as on the shaft-bearings of double, triple and quadruple expansion engines, or in other words an equal distribution of the strains on those different parts.

A complete balancing of the reciprocating parts is also a matter of very great importance, and is sometimes the cause of many mystified accidents to engines, both on locomotives, stationary and marine engines, when treated lightly. The friction of a steam engine of large size and good design is usually between 5% and 7% of its total power. It increases rapidly as the size of the engine decreases.

Having now somewhat outlined the growth and philosophy of the steam engine, though in intermittent, yet plain language, and made ourselves acquainted with that incalculable dormant energy and its transformation into useful and available knetic energy, through that familiar process of combustion until we find ourselves devising ways and means of controlling it so as to use it to the very best advantage and with as little cost as possible, we are now prepared to study the conditions which control our intelligent designers, and to endeavor to learn what are the lessons taught us by science and by experience in regard to the essential requisites of efficient working of steam and economy in the consumption of fuel. We may venture to point out the direction in which improvement is now progressing as indicated by a study of these requisites, and may be able to see the natural limits to such progress ; and we may conjecture, too, what must be the character of that change of type which can only take the engineer beyond the limit set to his advance, so long as he is confined to the construction of the present type of engine.

(The common slide valve on improved principles, the steam and exhaust ports, their arenas and formula for calculating size of same for different piston speeds, will come under the heading of "Design and Construction," in our next paper.)

An interesting engine test was recently conducted at the School of Practical Science, Toronto, by a joint committee of students, and members of Toronto No. 1, C. A. S. E. We hope to be able to furnish our readers at an early date with some particulars of these tests.

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*Paper read before the Montreal Electric Club.

ELECTRIC RAILWAY DEPARTMENT.

NEW POWER STATION OF THE MONTREAL STREET RAILWAY.

Following is a brief description of the equipment of the Montreal Street Railway Company's new power station :—

The engine house is two hundred and thirty-five feet long by eighty-nine feet wide, containing six 600 h. p. (nominal) engines built by Laurie Bros., of Montreal. They are horizontal cross-compound, condensing engines, with Corliss valves. Cylinders 24 inches and 48 inches, by 48-inch stroke, speeded to run 68 revolutions per minute, and guaranteed to develope above horse power at the most economical point of the cut-off, with a boiler pressure of 125 pounds. The drive wheel is 24 feet in diameter, with 54-inch face, double crowned, so as to drive two belts. Each engine will drive two 200 kilowatt generators. The gross weight of the fly wheel is 40 tons. Total weight of engines about 85 tons. The foundations on which the engines are built are of brick, cement and concrete. The depth of the foundations is about fifteen feet below floor level, and the weight fully six and a half times as much as that of the engines. The foundation bolts of the engines can be reached by a tunnel in the foundations. The engines are raised 7 feet above the street level, so as to keep them clear of possible floods in the springtime; and this accounts for the great depth of foundation. In the basement below the engines there are Worthington and Northey condensers, and the water for condensing and steam purposes is drawn from the Lachine canal in a 20 inch pipe. Connection is also made with the city mains, so as to supply water for steam purposes from that source, should the canal be run off at any time. The boiler house, adjoining the engine house, is 117 feet long by 93 feet 6 inches at the back, and 118 ft. in front. There are 12 Lancashire boilers, made by Daniel Adamson & Co., of Dukinfield, Manchester; size, 28 feet long by 7 feet diameter, working pressure 125 lbs. Each boiler is capable of giving over 300 h. p. The shells are in 8 courses or rings of one plate each, 5-8 in. thick. Green's economisers are built in the flue, and through them the feed water passes to each battery of boilers. The fire floor is raised in like manner to the engine floor, so as to avoid possible floods. The chimney stack is 186 feet above the level, 9 feet internal diameter. The main steam pipe is 18 inches in diameter. All the steam pipe has been supplied by McDougall Bros., of Montreal.

LEGAL DECISIONS.

STREET RAILWAY COMPANY V. CARRIERE, MONTREAL.—In this case the action was one of damages for injuries received while standing on the outside board of an open car. The action was for $50,000, and a judgment was delivered by the court in 1890, dismissing the action. On appeal by the plaintiff to the Court of the Queen's Bench, the judgment of the Queen's Bench 1893, reversed the judgment of the Superior Court, and allowed $600 damages to the plaintiff. Upon an appeal to the Supreme Court by the Montreal Street Railway Company, the appeal was quashed without costs, on the ground that the amount in dispute was under $2,000, the statute 54-55 Vic. ch. 25, not applying to the cases pending, following the decision of this court in Cowans v. Goans, decided last June.

JOYCE V. HALIFAX STREET RAILWAY COMPANY.—The charter of a street railway company required the road between, and for two feet outside of the rails, to be kept constantly in good repair and level with the rails. A horse crossing the track stepped on a grooved rail, and the caulk of his shoe caught in the groove and he was injured. In an action against the company by the owner, it appeared that the rail at the place where the accident occurred, was above the level of the roadway. *Held*, by the Supreme Court of Canada, affirming the judgment of the Supreme Court of Nova Scotia, that as the rail was above the road level, contrary to the requirements of the charter, it was a street obstruction unauthorized by statute, and therefore a nuisance, and the company was liable for the injury to the horse caused thereby.

LONDON STREET RAILWAY CO. V. CITY OF LONDON.—Judgment on appeal by the defendants from the judgment of Falconbridge, J., the trial judge, in favor of the plaintiffs in the action for an injunction to restain interference by the defendants with the construction of a track on a portion of the street railway line operated by the plaintiffs on Dundas street, west of Richmond street, in the city of London, Ont. Appeal allowed, judgment of trial judge set aside, and action dismissed with costs. The court held that the plaintiffs had no right to meddle with the roadway in question, except in so far as they are authorized by the by-law of the defendants, and the agreements ratifying its terms. Under the second clause of the by-law they are entitled to lay a single track at the point in question. Whether they are entitled along with this single track to lay "necessary side tracks, switches, and turnouts" is a matter in dispute which the court does not find it necessary to determine. Having a right to lay a single track and not a double track, they are obliged under the sixth clause of the by-law to lay it in the centre of the street, and as the gauge is fixed at four feet eight and a half inches, each rail of the single track should be two feet four and and a quarter inches, from the centre line of the street. Supposing them entitled to lay down a side track or switch, they must lay it on one side or other of their track, so that, for example, if they lay it down on the north side of their track, the whole south half of the roadway, excepting only two feet four and a half inches adjoining the centre line of the street, will be entirely unobstructed. The plaintiffs, instead of doing this, have laid down double tracks, the inner rail of each track being two feet from the center line of the street, with the result they occupy on each side of the center line of the street a space of at least six feet four and a half inches, besides the width of the rails, and the projecting portion of the ties. It is plain therefore that the plaintiffs, upon their own construction of the by-law, are interfering on one side or the other of the centre line of the street with a strip of the street upward of four feet in width, without any shadow of right. They, in fact, being forbidden to lay down a double track, insist upon their right to proceed to lay down what they call a single track and siding in a form and manner which cannot be distinguished from a double track, and in a form and manner forbidden in the case of a single track and siding. In so proceeding they were wholly without justification, and the defendants, being responsible by law for the condition of the highway, were well within their rights in interfering with the plaintiffs' work, and in restoring the highway to its proper condition.

SPARKS.

An electric railway connecting the villages of Pakenham and Kilburn, Ont., is talked of.

There is said to be under consideration a project for the construction of an electric railway between Belleville and Trenton.

The city of Hamilton received last year in percentage and mileage from the Hamilton Street Railway Company the sum of $12,504.67.

The Winnipeg Electric Street Railway Company is being requested to extend its lines to the thickly settled portions of the adjoining municipalities.

The name of the National Electric Tramway and Lighting Company, of Victoria, B. C., has been changed to the Victoria Electric Railway and Lighting Company.

Mr H. E. Andrews has been appointed president of the Cleveland Street Railway Company as successor to Mr. H. A. Everett, who held the position for two years previously.

The newly elected council of the village of Grimsby is said to be more favorably disposed towards the Hamilton, Grimsby and Beamsville Railway than the Council of 1893

An electric railway agitation is on foot at Cornwall, and it is reported that plans are being prepared with a view of utilizing for this purpose the power from the Moul nette dam.

It is stated to be the intention of the Rathbun Company, of Deseronto, who are the owners of the Thousand Island Railway between Gananoque and the G. T. R. main line, to operate the road by electricity.

A successful trial trip was made a few days ago over the Park and Island Railway line at Montreal. The tracks are laid on a solid stone foundation, T rails being employed. The St. Jean Baptiste Electric Company furnished the power for the operation of the road. Cars considerably larger in size than the ordinary city electric street cars are to be used. It is expected that at the end of the present year forty miles of track will have been constructed.

The Ontario Legislature will be asked to incorporate the Toronto and Suburban Railway Company, with power to acquire the assets and privileges of the City and Suburban Railway Company, Ltd., and the Davenport Street Railway Company, Ltd., and to use paid up stock in payment thereof, to assume the liabilities of these companies, and to have power to acquire other franchises. The capital stock of the company will be $250,000.

Messrs. A. E. Carpenter and R. R. Waddell, of Hamilton, who claim to hold a franchise from the Saltfleet Township Council, have taken possessiod of the only available route upon which an electric railway can be constructen to Hamilton Beach, and have commenced grading operations. In this action they appear to have forestalled the Hamilton, Grimsby and Beamsville Railway Company and the Hamilton Street Railway Company, both of whom had expressed their intention of running a trolley line to the Beach next summer.

At the annual meeting of the shareholders of the London Street Railway Company, held on January 18th, the following gentlemen were elected directors for the ensuing year: H. A. Everett, T. H. Smallman, Greene Pack, E. W. Moore, S. R. Break. The following officers were also elected: H. A. Everett, President; E W. Moore, Vice-President; S. R. Break, Secretary-Treasnrer and General Manager. The annual report for 1893 showed gross earnings to be $52,244.60, being an increase of $13,702.22 over the year 1892. The operating expenses for the same period were $40,696.93, leaving the net revenue $11,557.67, being an increase of $4,175.25 over 1892.

The Toronto Street Railway Company have been experimenting for some time past with the transportation of scavenging material from the city streets to Ashbridge's Bay, special cars being constructed and used for the purpose. The experiment has resulted successfully, and the company have offered to enter into an agreement with the city to carry garbage from any point within the limits of the city at the price of $1.50 per car per round trip, it being provided that the car shall not contain more than 10 tons of material. There are also provisions requiring the city to bear a share of the cost of switches and additional tracks required, and the company are not to be liable for the payment to the city of any percentage on the quoted price or mileage on track extensions. It is proposed that the agreement shall cover a period of ten years with option of renewal.

ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.

By Nikola Tesla.

(Continued.)

It is possible that the outer conducting air strata or free space contains an opposite charge and that, together with the earth, they form a condenser of very large capacity. In such case the period of vibration may be very low and an alternating dynamo machine might serve for the purpose of the experiment. I would then transform the current to a potential as high as it would be found possible and connect the ends of the high tension secondary to the ground and to the insulated body. By varying the frequency of the currents and carefully observing the potential of the insulated body and watching for the disturbance at the various neighboring points of the earth's surface resonance might be detected. Should as the majority of scientific men in all probability believe, the period be extremely small, then a dynamo machine would not do, and a proper electrical oscillator would have to be produced, and perhaps it might not to be possible to obtain such rapid vibrations. But whether this be possible or not, and whether the earth contains a charge or not, and whatever may be its period of vibration, it certainly is possible—for of this we have daily evidence—to produce some electrical disturbance sufficiently powerful to be perceptible by suitable instruments at any point of the earth's surface.

Assume that a source of alternating currents S be connected, as in Fig. 21, with one of its terminals to earth (conveniently to the water mains) and with the other to a body of large surface P. When the electric oscillation is set up there will be a movement of electricity in and out of P. and alternating currents will pass through the earth, converging to, or diverging from, the point C where the ground connection is made. In this manner neighboring points on the earth's surface within a certain radius will be disturbed. But the disturbance will diminish with the distance, and the distance at which the effect will still be perceptible will depend on the quantity of electricity set in motion. Since the body P is insulated, in order to displace a considerable quantity the potential of the source must be excessive, since there would limitations as to the surface of P. The conditions might be adjusted so that the generator or source S will set up the same electrical movement as though its circuit were closed. Thus it is certainly practicable to impress an electric vibration at least of a certain low period upon the earth, by means of proper machinery. At what distance such a vibration might be made perceptible can only be conjectured. I have on another occasion considered the question how the earth might behave to electric disturbances. There is no doubt that, since in such an experiment the electrical density at the surface could be but extremely small considering the size of the earth, the air would not act as a very disturbing factor and there would be not much energy lost through the action of the air, which would be the case if the density were great. Theoreically, then, it could not require a great amount of energy to produce a disturbance perceptible at great distance, or even all over the surface of the globe. Now it is quite certain that at any point within a certain radius of the source S a properly adjusted self-induction and capacity device can be set in action by resonance. But not only can this be done, but another source S_1, Fig. 21 similar to S, or any number of such sources can be set to work in synchronism with the latter and the vibration thus intensified and spread over a large area, or a flow of electricity produced to or from the source S_1 if the same be of opposite phase to the source S. I think that beyond doubt it is possible to operate electrical devices in a city through the ground or pipe system by resonance from an electrical oscillator located at a central point. But the practical solution of this problem would be of incomparably smaller benefit to man than the realization of the scheme of transmitting intelligence or perhaps power to any distance through the earth or environing medium. If this is at all possible, distance does not mean anything. Proper apparatus must first be produced by means of which the problem can be attacked, and I have devoted much thought to this subject. I am firmly convinced that it can be done and hope that we shall live to see it done.

ON THE LIGHT PHENOMENA PRODUCED BY HIGH-FREQUENCY CURRENTS OF HIGH POTENTIAL, AND GENERAL REMARKS RELATING TO THE SUBJECT.

Returning now to the light effects which it has been the chief object to investigate, it is thought proper to divide these effects into four classes: 1. Incandescence of a solid, 2. Phosphorescence. 3. Incandescence or phosphorescence of a rarefied gas, and 4. Luminosity produced in a gas at ordinary pressure. The first question is, How are these luminous effects produced? In order to answer this question as satisfactorily as I am able to do in the light of accepted views and with the experience acquired, and to add some interest to this demonstration, I shall dwell here upon a feature which I consider of great importance, inasmuch as it promises, besides, to throw a better light upon the nature of most of the phenomena produced by high-frequency electric currents. I have on other occasions pointed out the great importance of the presence of the rarefied gas, or atomic medium in general, around the conductor through which alternate currents of high frequency are passed, as regards the heating of the conductor by the currents. My experiments described some time ago have shown that the higher the frequency and potential difference of the currents, the more important becomes the rarefied gas in which the conductor is immersed, as a factor of the heating. The potential difference, however, is, as I then pointed out, a more important element than the frequency. When both of these are sufficiently high, the heating may be almost entirely due to the presence of the rarefied gas. The experiments to follow will show the importance of the rarefied gas, or generally of gas at ordinary or other pressure as regards the incandescence or other luminous effects produced by currents of this kind.

I take two ordinary 50-volt 16-c. p. lamps which are in every respect alike, with the exception that one has been opened at the top and the air has filled the bulb, while the other is at the ordinary degree of exhaustion of commercial lamps. When I attach the lamp, which is exhausted, to terminal of the secondary of the coil, which I have already used as in experiments illustrated in Fig. 15*a* for instance, and turn on the current, the filament, as you have before seen, comes to high incandescence. When I attach before the second lamp, which is filled with air, instead of the former, the filament still glows, but much less brightly. This experiment illustrates only in part the truth of the statements before made. The importance of the filament's being immersed in rarefied gas is plainly noticeable, but not to such a degree as might be desirable. The reason is that the secondary of this coil is wound for the low tension, having only 150 turns, and the potential difference at the terminals of the lamp is therefore small. Were I to take another coil with many more turns in the secondary, the effect would be increased, since it depends partly on the potential difference, as before remarked. But since the effect likewise depends on the frequency, it may be properly stated that it depends on the time rate of the vibration of the potential difference. The greater this vibration, the more important becomes the gas as an element of heating. I can produce a much greater rate of vibration in another way, which besides has the advantage of doing away with the objections which might be made in the experiment just shown, even if both the lamps were connected in series or multiple arc to the coil, namely, that in consequence of the reactions existing between the primary and secondary coil the conclusions are rendered uncertain. This result I secure by charging from an ordinary transformer, which is fed from the alternating currents supply station, a battery of condensers, and discharging the latter directly through a circuit of small self- induction, as before illustrated in Figs, 19a, 19b, 19c.

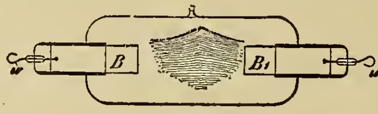

Fig. 33

Carbon Deposit in Tube in a Magnetic Field.

In Fig. 22a, 22b and 22c the heavy copper bars B, B_1 are connected to the opposite coating of a battery of condensers, or generally in such a way that the high frequency or sudden discharges are made to traverse them. I connect first an ordinary 50-volt incandescent lamp to the bars by means of the clamps c, c. The discharges being passed through the lamp, the filament is rendered incandescent, though the current through it is very small, and would not be nearly sufficient to produce a visible effect under the conditions of ordinary use of the lamp. Instead of this I now attach to the bars another lamp exactly like the first, but with the seal broken off, the bulb being therefore filled with air at ordinary pressure. When the discharges are directed through the filament, as before, it does not become incandescent. But the result might still be attributed to one of the many possible reactions. I therefore connect both the lamps in multiple arc as illustrated in Fig' 22a. Passing the discharges through both the lamps, again the filament in the exhausted lamp l glows very brightly, while that in the non-exhausted lamp l_1 remains dark, as previously. But it should not be thought that the latter lamp is taking only a small fraction of the energy supplied to both the lamps; on the contrary it may consume a considerable portion of the energy, and it may become even hotter than the one which burns brightly.

(To be Continued.)

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Apparatus for Long Distance Transmission of Power.

WE MANUFACTURE IN CANADA EVERY DESCRIPTION OF ELECTRICAL MACHINERY AND ELECTRICAL SUPPLIES.

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Our wire factory is one of the best equipped on the continent.

We manufacture every description of insulated wires and cables, and our large production enables us to offer special values.

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Standard Weatherproof Wires,
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Our solid core Rubber Covered Wire has the best insulation resistance, best quality of rubber, and gives the most general satisfaction to users.

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To no other class of apparatus can the axiom that "the best is the cheapest" be more truly applied than to electrical machinery and appliances. To transformers does this especially apply. It will pay you to buy the best in the market, and we now offer you the very best at such a reduced price that the essentials of quality and efficiency are combined with extremely low prices, which is rendered possible only by the introduction of improved labor-saving machinery, added to a large increase in our output.

The Transformer we offer is the improved type F. Thomson-Houston design, celebrated for its high efficiency and perfect regulation.

The following points in a Transformer are all essential: (1) Perfect safety; (2) high efficiency; (3) good regulation; (4) small core loss; (5) convenience in installation.

These are attained in the New Type F. Oil Insulated Transformers (which we are now manufacturing at our works at Peterborough, Ont.), in a greater degree than any other upon the market.

Write to nearest office for prices and discounts.

INCANDESCENT LAMPS

We have, during the past two months made such changes and improvements in our methods of manufacture, and in the general appearance of our lamps, that we offer you, with confidence, a lamp that we are assured is now superior to any other in the market.

We have adopted an entirely new method of treating and handling our carbons, and have so improved our methods of inspecting and testing throughout each department and process that all inherent defects are eliminated before the lamps are passed for shipment.

Price list and discounts furnished on application.

OUR LAMP SOCKETS ARE THE BEST AND CHEAPEST IN THE MARKET.

TRADE NOTES.

The Canada Vinegar Works have just placed in their factory a Kay dynamo.

The Worsted and Braid Co., Toronto Junction, have installed a Kay dynamo.

A. R. Woodyat & Co., of Guelph, have placed in their plating rooms a Kay electric plating machine.

Wm. Buck, stove founder, Brantford, has just installed in his plating room a new Kay electric plating machine.

The Kay Electric Works have just installed a 400 light incandescent plant for Thos. Eagen, of Tottenham.

The Kay Electric Works have installed an electric plant in J. Hooper's blacksmith and machine shop in Guelph.

The reader who wishes to enjoy a good laugh should turn to the advertisement in this issue of the Packard Lamp Co.

The Acme Silver Company, of Toronto, have added to their extensive plant a Kay electro plating machine of large capacity.

The towns of Dundas, Ont., and East Toronto, Ont., have awarded contracts for fire alarm systems to Messrs. T. W. Ness & Co., of Montreal and Toronto.

The Curtain and Upholstery factory of Guelph have just installed a Kay motor of 15 h. p. and are going extensively into this line of manufacture.

Messrs. John T. Cassidy and Albert William Bonner have formed a partnership in Montreal to manufacture leather belting, the firm name being Cassidy, Bonner & Co.

The Eugene Phillips Electrical Works, of Montreal, have secured the order for the wire required in the construction of the Hamilton, Grimsby and Beamsville Electric Railway.

The Roman Catholic Church of Stratford have just rebuilt their organ, and are now running it by electricity; motor and attachments supplied and set up by the Kay Electric Works, of Hamilton.

The Montreal Park and Island Railway Company are operating nine miles of line between Montreal and Sault au Recollet. Three double truck cars are used, equipped with the Westinghouse system by Messrs. Ahearn & Soper, of Ottawa.

The Canadian Locomotive and Engine Company, of Kingston, have obtained the contract, in competition with American firms, for the construction of two large locomotive engines required for use on the Intercolonial Railway. Each engine will have ten driving wheels.

At the factory of T. W. Ness & Co., Montreal, they are now making a specialty of changing crystal and other gas fixtures into electric, and have recently done considerable in this line in connection with their contracts for Henry Mussen, C. G. Hope, John Hope and F. L. Wanklyn.

The contract for eleven cars required for the equipment of the Hamilton, Grimsby and Beamsville Electric Railway has been awarded to Messrs. Ahearn & Soper, of Ottawa. It is expected that the line will be in operation between Hamilton and Grimsby Park by the first of July next.

The Kay Electric Works, in conjunction with Leitch & Turnbull, elevator manufacturers, of Hamilton, have installed in J. Hoodless & Co.'s extensive warehouse an electric elevator; its simplicity of construction, neatness of design and solidity of every part should commend it to any one needing a machine of this kind.

At the General Electric Company's workshops at Peterboro', Ont., there has just been completed an electric snow plow for the Kingston Electric Street Railway. It is 21 feet long by 6 feet wide, and propelled by two 25 h. p. single reduction motors.

Messrs. Robin & Sadler, manufacturers of leather belting, Montreal and Toronto, have sent out a card wishing their customers the compliments of the season, and stating that notwithstanding the keenest competition, they have secured an ample share of orders during the year which has just closed, while at the same time maintaining their reputation for first-class workmanship.

The following letter by Mr. L. H. Reesor, proprietor of the St. Mary's Electric Light and Power Company, to the Dodge Wood Split Pulley Co., of Toronto, is a sample of many letters received by the Dodge people in praise of their new and improved dynamo pulley: "Enclosed find money order for $7.50, being amount of account for dynamo pulleys. The pulleys are giving excellent satisfaction."

Sales of Reliance motors have recently been made by T. W. Ness & Co. as follows: Messrs. P. D. Dods & Co , of the Island City Paint Works, dynamo for lighting; Waters Bros., printers, Montreal, motor; H. P. Labelle & Co., furniture manufacturers, Montreal, dynamo; G. H. Harrower, Novelty Stamp Co., Kerr & Morgan, Christian Bros., John Burns, H. H. Thurston, Montreal Show Case Co. and the Montreal Dress Stay Co., motors.

Messrs. T. W. Ness & Co., Montreal, have recently installed private telephone systems for the following firms: Messrs. W. J. Gage & Co., Warwick Sons & Rutter, and Brough & Caswell, Toronto; Grafton & Co., Dundas; the Central Prison, Toronto; Messrs. P. Green, Sons & Co. and the Sabiston Litho. Co. (using the new patented automatic switch telephone), Thompson & Co., Craig St., Montreal; Canada Life Assurance Co., Hamilton: Christie, Brown & Co., Toronto.

Messrs. T. W. Ness & Co., Montreal, have recently filled wiring contracts as follows: The new residences of Messrs. R. B. Angus, Duncan McIntyre, Henry Husson, and the manager of the Bank of Montreal; also the Protestant Orphan Asylum, new Bank of Toronto building, corner St. James and McGill streets, Montreal; M. Lefebvre & Co.'s beet root sugar factory, Berthierville, Que.; the new Beard estate building on Jarvis street, Toronto; Messrs. M. Moody & Sons, of Terrebonne, Que.; St. Andrew's Church, Carleton Place, Ont.

The Vankleek Hill Electric Light Company, the capital stock of which has just been increased to $10,000, have recently completed a new power station in which has been installed a 60 h. p. engine, three large dynamos and a power generator. The company has already received numerous applications for power.

The Bell Telephone Company are rapidly removing their poles and wires from the streets of Toronto and placing them underground, and at the present rate of progress it is probable that the whole of the company's system will have gone underground prior to the expiration of the time stated by its agreement with the city for the completion of the work. Three-fourths of the telephones are connected with metallic circuits. Last year there were added to the company's list of subscribers, 350 names.

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Reliance ...
Automatic ...
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PERFECTLY AUTOMATIC,
FROM ONE LIGHT TO FULL LOAD.

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SPARKS.

It is reported that next summer telephone lines are to be established throughout Manitoulin Island.

An employee of the electric light station at Harriston, Ont., named Thamas Davy, was recently killed while alone with the machinery, by being caught in the shafting.

Mr. George Morgan, of Sarnia, has recently purchased the large waggon and carriage works belonging to the Lowrie estate, with the purpose, it is said, of establishing electric works.

Severe damage was done to the wires of the telegraph, telephone, and electric light comoanies by a wind and snow storm which passed over the city of Winnipeg on the 11th of January.

By the bursting of an armature in the electric power station at Orillia, Ont., the engineer in charge, Mr. Ritchie, narrowly escaped losing his life, while the town was temporarily shrouded in darkness.

As the result of a dispute between the Council of the city of Three Rivers and the Royal Electric Company, over the character of the plant supplied by the latter to the corporation, the company have given notice of their intention to shut down the lighting station.

A local paper states that the Royal Electric Company have submitted to the town council of Aurora, a proposition to light the streets, business places and residences (where required), at a flat rate of 2½ cents per 16 c. p. lamp per night, light to be furnished every night in the year, from dusk until midnight.

Mr. James Ross, of the Montreal Street Railway Company, accompanied by Mr. F. L. Wanklin, one of the company's engineers, lately made a visit of inspection to a number of American street railway power stations with the object of becoming acquainted with the most improved methods of equipment.

The water power which is being developed by the Keewatin and Rat Portage Power Company is stated to be the greatest on the continent. The company propose to spend a quarter of a million dollars for the utilization of this power, the purpose being to furnish power to the towns of Keewatin and Rat Portage.

Messrs. Conroy Bros. propose to utilize electric cars operated by storage batteries to draw wet lumber and refuse from their saw mills at Deschenes, Que., through the piling grounds. It is also said to be the intention of the firm to install a dynamo from which to supply current for lighting the streets of the town of Aylmer, Que.

Experiments have lately been conducted at the waterworks pumping station at Toronto Junction with the purpose of deciding the relative economy of hard coal versus screenings as fuel. It has been decided to purchase a blower and use screenings. It is claimed that by this method a saving of $2 per day can be effected.

The annual election of officers of the Canadian Marine Engineers' Association took place on January 24th. and resulted as follows: President, O. P. St. John, ex-Government Steamboat Inspector (elected by acclamation); 1st Vice-President, J. C. McFadden; 2nd Vice-President, E. O. Dell; Council, J. F. Corrin, D. L. Foley, J. D. Banks, Thos Good, J. S. Adam; Treasurer, J. H. Ellis (elected by acclamation); Secretary, F. E. Smith (elected by acclamation); Auditors, S. Gillespie, J. A. Findlay; Inside Guard, J. Hopkins.

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PRIVATE AND LOCAL TELEPHONE SYSTEMS, BURGLAR ALARMS, HOTEL, ELEVATOR AND OTHER ANNUNCIATORS, HOTEL ROOM AND FIRE CALL BELLS, ELECTRIC BELLS, PUSH . . . . BUTTONS, ETC. . . . .

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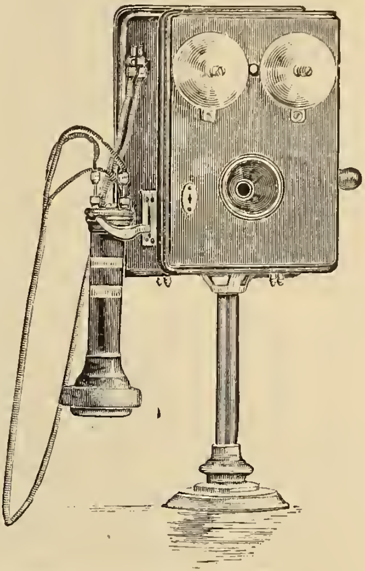

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Letters patent have been issued increasing the capital stock of the Vankleek Hill Electric Company, Ltd., from $3,000 to $10,000.

At a recent meeting of Toronto Association No. 1, C. A. S. E., a badge and button to be worn by the members was adopted.

The annual meeting of the shareholders of the Niagara Falls Park and River Railway Company will be held at the office of the company, No. 18 King Street West, Toronto, on Tuesday, the 6th inst., at noon.

The company who have undertaken the development of electric power on the Canadian side of the Niagara Falls are said to have agreed to be in a position to deliver on the first of November, 1898, 25,000 horse power.

The Toronto Railway Company have been negotiating with the Siemens-Halske Company, of Chicago, with a view to the purchase of the 5,000 h. p. engine exhibited at the World's Fair, and especially designed for electric purposes.

Mr. H. G. Hunt, of St. Catharines, has in his possession a receipt for a payment of five shares of capital stock in the Toronto, Hamilton and Niagara Electric Magnetic Telegraphic Company. The receipt is dated the 18th of January, 1847.

It is said to be the intention of the executive committee of the Street Railway Men's Union of Toronto to issue a call for a convention of employees of the different street railway companies throughout Canada, with the object of establishing a federation of the various local unions, and of regulating the hours of labor and arranging a scale of wages.

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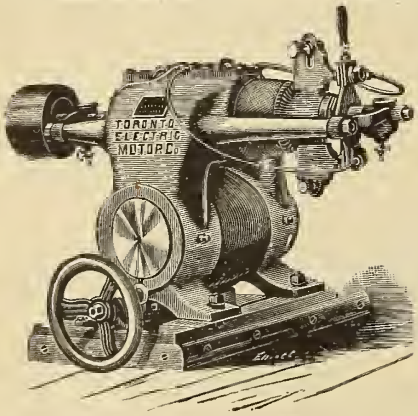
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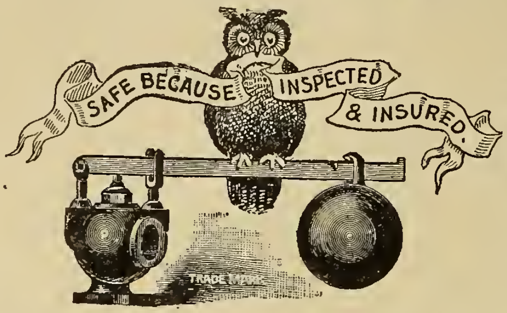

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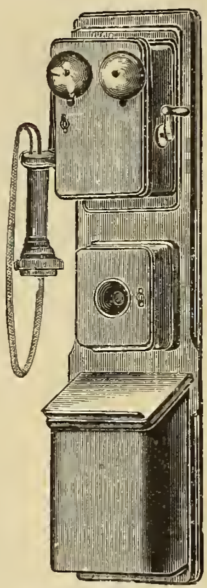

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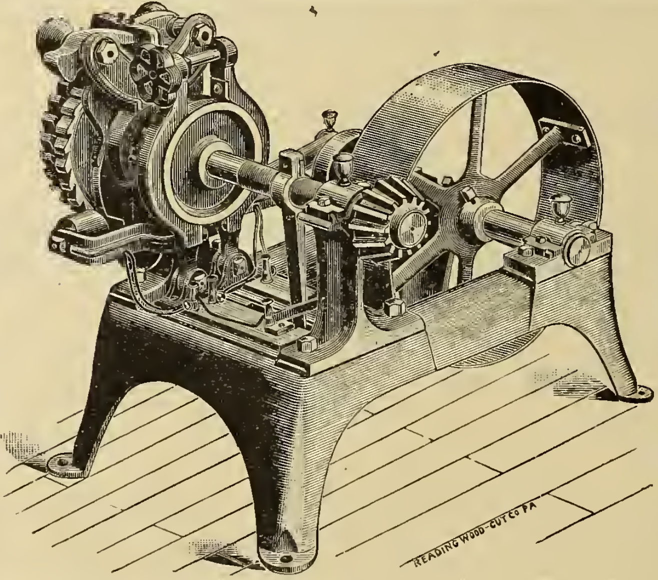

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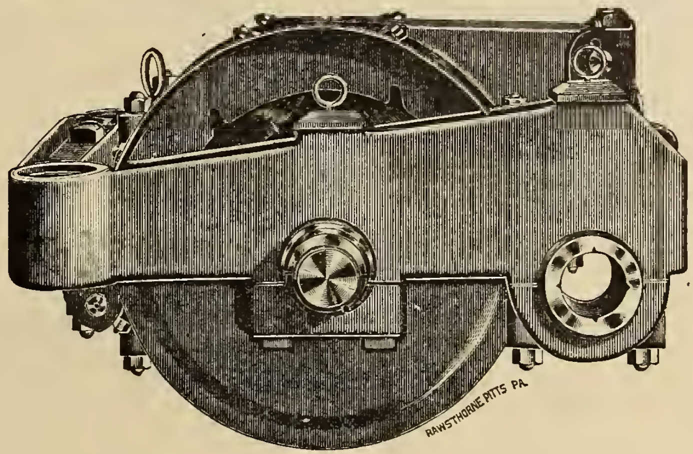
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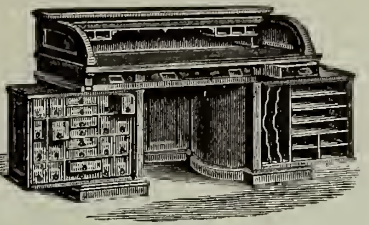

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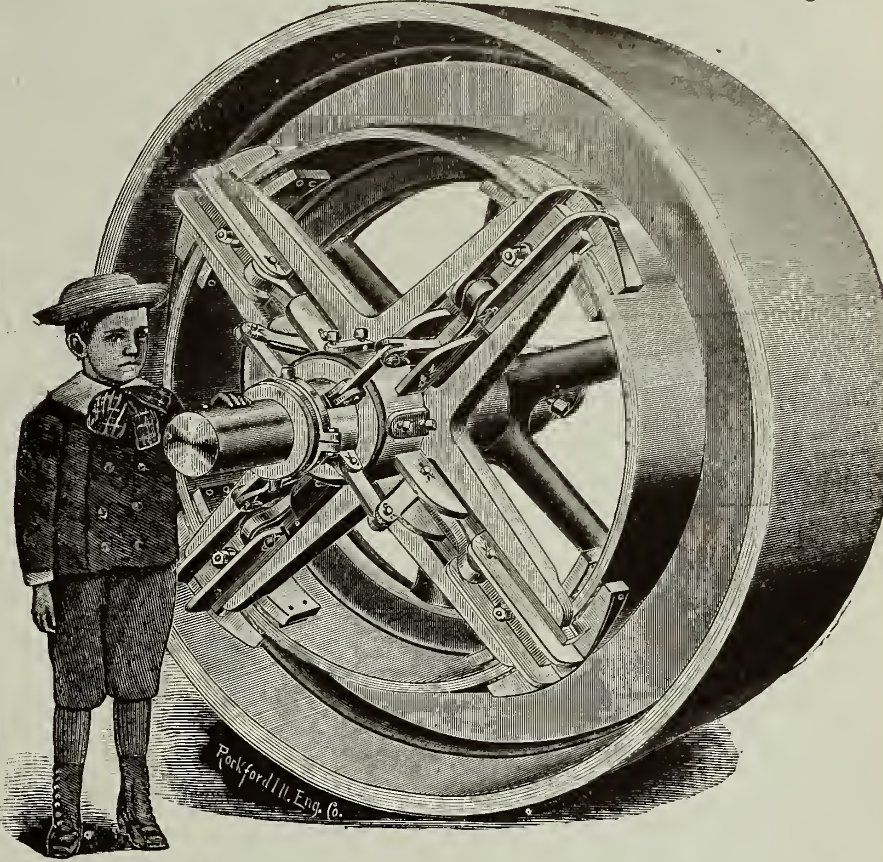
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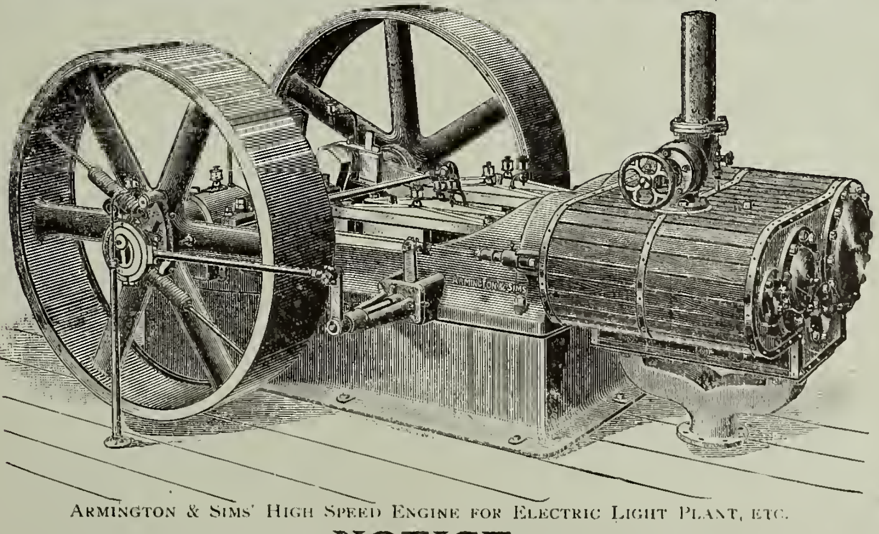

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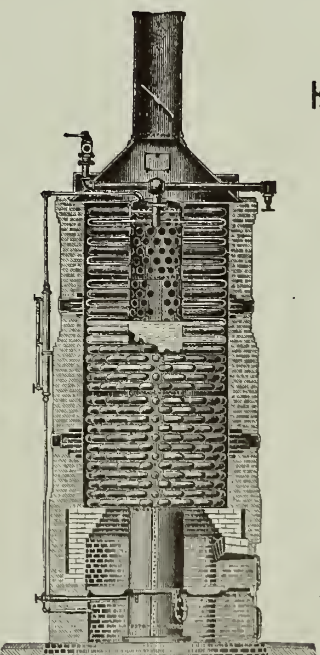

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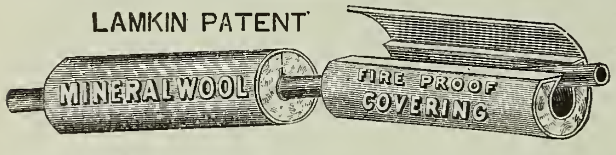

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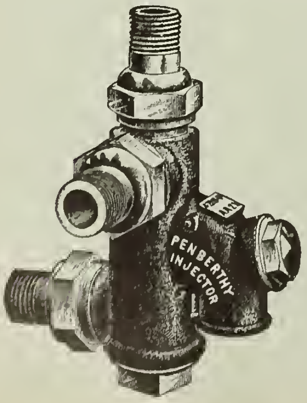

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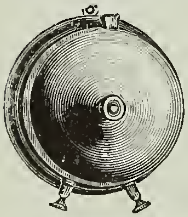

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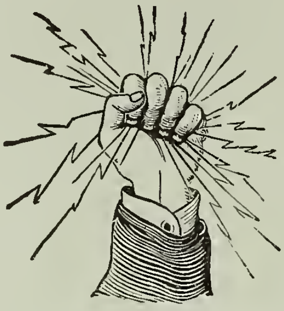

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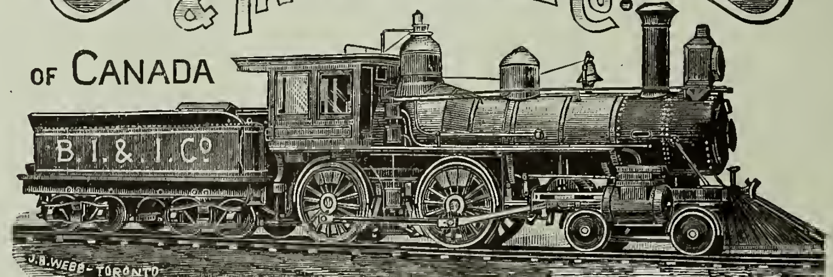

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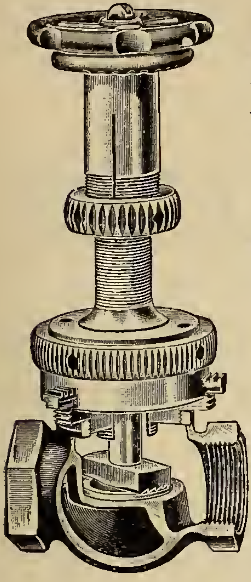

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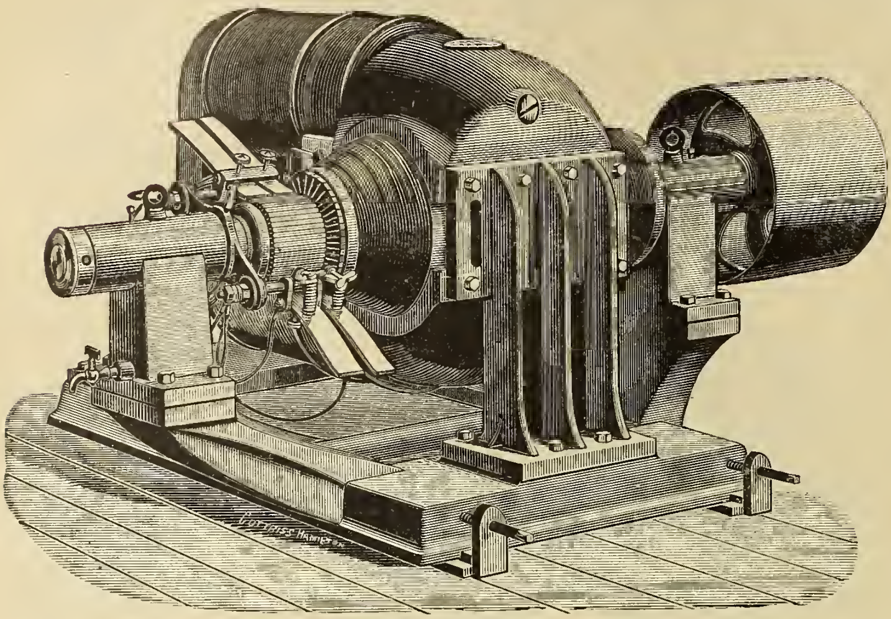

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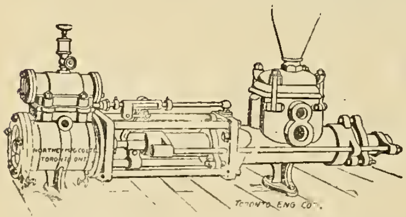

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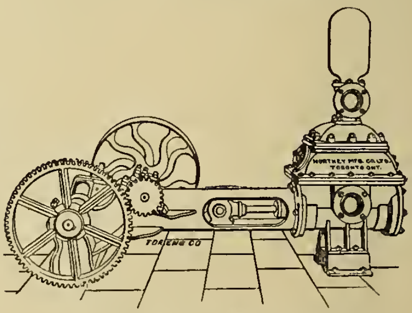

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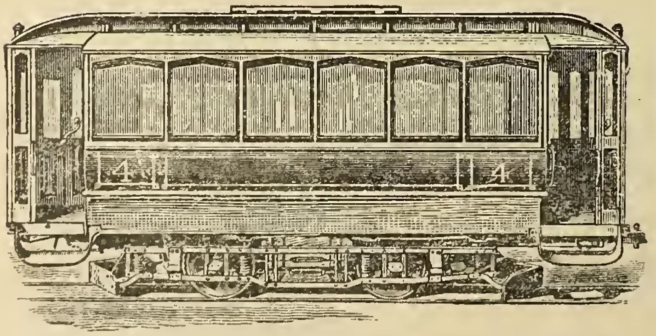

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SAMPLE LETTER.

MONTREAL, Oct. 10, 1893.

MESSRS. T. W. NESS & CO.,
749 Craig St., Montreal, P. Q.

DEAR SIRS:—In reply to yours of the 9th, we beg to say that we have used one of your Automatic Telephones for some time, and find it satisfactory in every respect.

Yours truly,
GREEN & SONS CO.

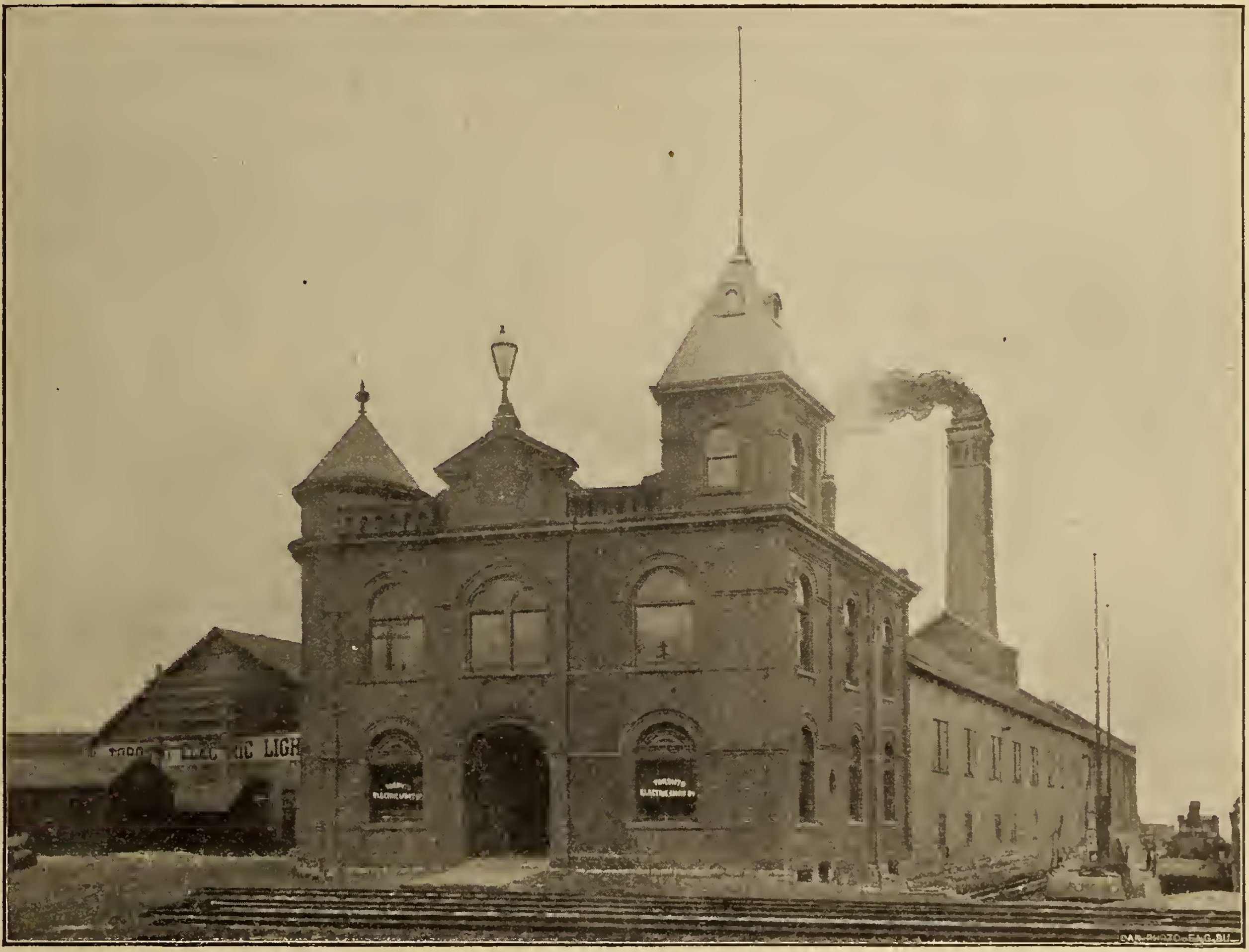
T. W. NESS & CO.
749 Craig St. - MONTREAL.

CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. IV. MARCH, 1894 NO. 3.

THE TORONTO ELECTRIC LIGHT COMPANY'S NEW STATION.

THE accompanying illustration represents the new buildings and plant of the Toronto Electric Light Company. They consist of spacious engine and dynamo rooms, boiler house and office. The offices, as seen in the cut, front the Esplanade at the corner of Scott street. On the ground floor are the public offices, manager's office, private room and lavatory; on the second floor is a large room used as a board-room, library, with spiral staircase to tower, laboratory and instrument room, and clerk's private room. The interior finish is all quartered oak, polished, which presents a very handsome appearance. The dynamo room immediately in rear of the offices contains the power generators for the 250 and 500 volt systems on the main floor, with smaller dynamos for arc lighting on a raised platform over the shafting. The whole is driven by the pair of compound vertical Corliss engines of one thousand horse power, of which we gave an illustration in a previous number. Further on is the boiler house, of brick, containing four water tube boilers of 250 h. p. capacity each, with accommodation for double that amount. The brick chimney shaft is 22 feet square at the foundation and 125 feet in height, having a square flue parallel from bottom to top, 8 feet on each side. The foundations for boiler and engines are of the most massive character, and required considerable skill in their design and execution, as the whole had to be built on the mud bottom of the slip, and at the same time the depth of water had to be maintained in the dock alongside. As the slip could not be filled up, piles were driven to the rock and cut off by a specially designed circular saw about two feet below the water. On these massive stones were laid, some of which weighed over three tons, the interstices of the piling being filled with broken stone and cement. Upon the lower courses of large stones the engine and boiler foundations were built, and are found after a year's use to be as firm and solid as ever.



The smoke-stack was built on a similar foundation, poles being driven as close together as possible over the whole area. Difficulty was found here, as there was only about two feet of loose mud over the rock, not enough in some cases to hold the piles down in the ten feet of water that was over it. Now that the entire work is completed, however, its solidity and freedom from vibration leaves nothing to be desired. The advantages in being at the headquarters of fuel supply and having unlimited water at command for boiler supply and condensing purposes, far more than compensate for the extra difficulty and expense of obtaining a good foundation.

The extension of the company's wharves to the new line afford abundant room for coal storage and a pole yard, the size being 600 by 140 feet. The whole of the work, including foundations and superstructure, was designed by and executed under the immediate supervision of the manager of the company, Mr. J. J. Wright.

The recent storms are said to have cost the Bell Telephone Company about $45,000 for repairs to their system in Eastern Ontario.

The town council of Carleton Place, Ont., have been considering the question of granting a bonus of $20,000 and exemption from taxes for 15 years, to Messrs. T. W. Ness & Co., of Montreal, for the purpose of inducing them to remove their manufactory to that place. Application is to be made to the Ontario Legislature for authority to carry out the undertaking. A condition of the bargain is that Messrs. Ness & Co. must employ constantly an average of 100 hands.

QUESTIONS AND ANSWERS.

J. W. R., Hamilton, Ont., writes :—The Hamilton Spectator states that the new Blake pumping engine at Toronto has had to have a new set of pumps placed in it, and that it has been standing idle for the last two months for this purpose. This engine broke down disastrously soon after its erection last year. As no account of it has appeared in the Toronto daily papers, the stationary engineers would like your account of the trouble. The Hamilton 8,000,000 gallon pump has now run six years without any trouble whatever, and with great fuel economy ; so also have the Kingston and London ones—all built here by Killey.

ANSWER.—We have made inquiries of the officials of the Toronto Waterworks Department respecting the subject of our correspondent's inquiry, and are informed that the first breakdown of the Blake engine took place while the engine was under test by the manufacturers, and before its acceptance by the city. The break down was due to the breaking of the crank pin, as the result of which the cylinder head of the engine was blown out. The breaking of the crank pin is said to have been caused by an internal flaw in the metal which was not observable on the surface. The engine was again shut down on the evening of the 8th of January, and has not been in operation since. It is stated that after the engine had been for some time in operation the manufacturers concluded that the cylinders were not sufficiently heavy for the unusually severe work which was required of them, and decided to replace them by cylinders of greater weight. To do this required the shutting down of the machine for about six weeks. This is the explanation of the difficulty as it has been given to us by the officials of the Department.

"Meter," Arnprior, Ont., writes : Would you please answer through your journal the following questions :

1. Kindly give the principle of construction of alternating current motors to drive fans.

2. What would be the effect in the reading of a Shallenberger meter, certified correct with 16,000 alternations per minute, if the alternations were lowered to 14,000?

3. What are the qualifications necessary to obtain 2nd class engineer's papers, and what books do you recommend as being useful in qualifying for papers?

4. What kind of storage battery is best adapted for a boat with one h. p. motor ; also weight of batteries that would supply 1 h. p. motor for 12 hours, they being charged by a 4 ampere circuit of about 500 volts?

ANSWER.—The time at our disposal will not admit of an answer being given until our April issue. 2. The storage battery having the least weight for a given output is best suited for boat propulsion, but the numerous forms of lead plate batteries differ very little from each other in this respect. Their average weight, with cells and acid solution complete, is about 140 pounds for a capacity (at normal discharge rate) of 1 kilowatt hour. For a one h. p. motor running 12 hours, i. e., for 12 horse power hours delivered by your motor, you should provide at least 12 kilowatt hours battery capacity. We should say that 500 volts is too high a voltage for use in a boat, on account of insulation difficulties. 100 volts is quite as high as can be managed comfortably. 3. This information may be obtained by writing to any member of the Board of Examiners of the Ontario Engineers Association. The names and addresses of the examiners are printed on our editorial page. 4. The Shallenberger meter readings will not be correct on a circuit of different frequency from that for which the meter is adjusted, but not in proportion to the number of alternations per minute. A little adjustment can be made in the meter fro change of frequency by changing the angle of the secondary coil. The makers state "the meter is practically correct within 1000 alternations per minute above or below that or which it is adjusted."

TELEGRAPHIC REVOLUTIONS.

THE days for the use of the primary battery for telegraphy in this country are numbered. It will not be long before the batteries that are now used in the various stations of the New England states will be relegated to antiquity. At the main Boston office, where 14,000 cells were employed for sending messages the first year, occupying one-fifth to one-sixth the space, there are now motor dynamos which take up but a small room in the basement. The advantages of the motor dynamo or transformers, as they are generally called, are many.

The saving alone over the whole system is said to be between 40 and 45 per cent. This remains to be demonstrated, however. Then, again, the new practice has the great advantage of cleanliness and steadiness.

With the use of the cells the voltage varied from 26 to 36 points from the standard of 180 volts supposed to be delivered. With the motor dynamo as a generator of current, there is hardly any variation ; at the most, 2 or 3 volts. The motor dynamo transforms or reduces the ordinary direct incandescent light current into one of small volume for the telegraph business.

In the Western Union Company's Boston office the current is taken in a commutator on one side of the machine and sent out from a commutator on the opposite side, the transformation being effected by two different windings on the armature.

The Boston plant has at present nineteen of these transformers in use and will put in addition probably ten more. Of these machines now in use five are of 3 horse-power each, three are 1 one-horse, two are ½ horse-power, two are ¼ horse-power and seven are ⅙ horse-power. The potential of these machines varies anywhere from 25 up to 260.

The farthest point to which a message has to be sent from Boston is Buffalo, N. Y., and this can be accomplished by throwing one large machine of 260 into service, or several connected in tandem, or in series. The small machines, which are wound from 50 to 70 volts, are thrown into what is known as the loop from New York to Portland, thus necessitating the send of but one message.

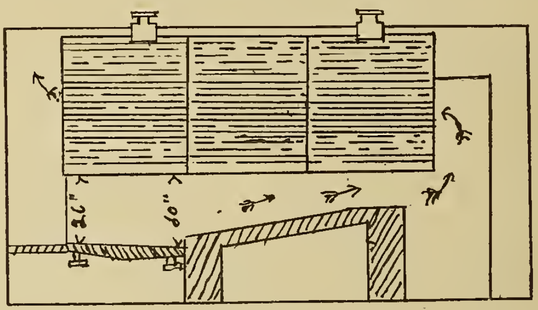
METHODS OF BOILER SETTING.

Editor ELECTRICAL NEWS.

SIR,—In response to the request of the Hamilton Association C. A. S. E. re boiler setting in your last issue, I would like to give a little of my experience in that line. But first let me say, that it is with no desire to criticise my Hamilton friends or assail the decision they may have arrived at on this important subject; but simply to get and try to give information, that being the object of the C. A. S. E.

About eighteen months ago I took charge of a new plant; the boiler is 14 ft. × 66″, and was bricked in before I took charge and was set somewhat like the sketch of the Hamilton plant referred to above, with the bridge built perpendicular and circled round the boiler; but it did not give the satisfaction I would like.

About a month ago, another boiler of exactly the same dimensions, and built by the same firm, was placed by the side of the first one. With boiler No. 2 I was more anxious to have a little of my own way, as regards the setting, and the firm gave instructions that my wishes should be attended to in every particular. This is a rough sketch of the setting :



Now here are two boilers identical in every respect, but which differ in the setting ; No. 1 has the plumb bridge which is circled and built to within 8″ of the boiler. Now it will be seen by looking at the sketch that the greatest heat will strike the boiler at or near the bridge, and in this case on one of the two seams running around it. In No. 2 there is practically no bridge wall, only raised about 6″ to keep the coal in place, then a flat bed sloping to within 10″ of the boiler.

It is only just to say that I have not been able to weigh the coal and water and make a thorough test of the two boilers separately, but I have no hesitation in saying that No. 2 makes more steam and is more satisfactory in every respect than No. 1. That this is the case is particularly noticeable in getting up steam and before they are connected together; the steam in No. 2 always gains from 10 to 15 lbs. on No. 1. I believe the greater advantage lies in the more equal distribution of the heat under the boiler, and at the same time the liability to unequal expansion is lessened. I might give other reasons for recommending this plan of setting, but will refrain lest I should take up too much space.

GEO. GILCHRIST,
Toronto No. 1 C.A.S.E.

According to the decision of the Supreme Court of Georgia in The Western Union Telegraph Company vs. Rountree, under the act of October 22, 1887, a telegraph company is not liable for the penalty of $100 for a verbal, though material, inaccuracy in the transmission of a message, and the words "shall transmit and deliver * * * with impartiality and good faith, and with due diligence," relate, so far as the purposes of this act is concerned, to the time within which the transmission and delivery must be accomplished, and not to accuracy and correctness in sending and transcribing dispatches. In the case of The Western Union Telegraph Company vs. Timmons the court held that a non-resident of a city does not make himself a resident within the meaning of the proviso to the second section of the act of October, 22, 1887, touching the duties of telegraph companies, by giving to the company an address within the city at which he can be found temporarily. The second section of the act, the court said, deals exclusively with the duty of delivery to residents of cities and towns, and persons residing within a limit of one mile from the telegraph office. The duty of delivery to other persons is not embraced in that section, but in the general requirement set forth in the first section ; and as to non-residents, the question whether due diligence in making delivery requires the company to go outside of its office to deliver at a designated place within a city or town is one of fact for the determination of a jury on the circumstances of each case, including any right and reasonable usage of the company in dealing with messages of this kind, and if the company in the conduct of its business delivers outside of its office to one customer it must to another under like circumstances and conditions.

THE ECONOMICAL INSTALLATION OF SMALL LIGHTING PLANTS.

By J. B. Cahoon.

A careful investigation of the small electric light plants throughout the country will show, says the Electrical World, that many of them are only just barely clearing expenses, without netting any profit to the owners; as many more are running at a loss, while a very few are a source of profit. One fault of these stations which tends to make them non-profitable is the lack of economy in their operation. By economy we mean a true spirit of economy, and not a spirit of parsimony which sometimes passes for economy among the people who have considerable to do with electric properties. But leaving this out of the question, if we were to take a very small plant, say one running 600 or 700 incandescent lights, and try to run this at a profit in a country town, we find that, handling this as best we can with the old methods, there is little or no profit derived from its operation, especially if we charge off a certain percentage for depreciation each year. Now let us look into this a little more closely and see if we can ascertain why such a plant should not yield a fair return on the investment. In the first place, situated as our plant is in a country village with its long, straggling streets and extensive distances to cover, with only an occasional store, and here and there a light to be placed on the highway, if we run the two-wire system and use the direct current incandescent machine, we find that we are using a great deal of copper to maintain the required service, and that the cost of this copper is so great that the return for the use of the few scattered lights is insufficient to pay a fair rate of interest on so much copper.

We can resort to the alternating current and distribute at a potential of 1,000 or 2,000 volts, as the case may be, and so cover the main points to be lighted at a fairly reasonable outlay, but this will necessitate the use of a large number of small transformers, which means the production of light at a less efficiency and greater expense than if we could make use of large transformers. This will, however, furnish us with an incandescent system of lighting from which we can hope for some return of our investment. Or, we can install an arc plant which will enable us to distribute lights over the required area, and this will be perfectly satisfactory for street lighting and for use in some large buildings and stores, but it will not meet the demand for lighting private houses, small stores, and the various odds and ends which are liable to require light; therefore it is questionable if the arc light plant will be a profitable one, and it cannot contract for any of the small installations and practically will only serve to light the town. Again, as we start with the assumption that the town is too small to warrant the installation of both arc and incandescent circuits, it becomes necessary to decide upon some plan which will meet all conditions in a fairly satisfactory manner. After carefully watching the operation of alternating circuits with three-wire transformers I am convinced that this three-wire transformer system is the one which will be the most profitable to install in such places as mentioned above, as well as in larger towns and cities where distribution is to be made at long distances from the central stations and over a considerable area.

The system is an extremely simple one and is well illustrated by the plant of the Peterborough Electric Light and Power Company, Peterborough, N. H. In brief, the idea is to place large transformers at certain points, which may be called centres of distribution for the area in which said transformers are situated, carrying the primary to those transformers at 1,000 to 2,000 volts and running off three wires from the secondary coils and carrying these along the streets to the points where they are needed. The difference of potential between the two outside lines will be 104, and between the middle and outside lines 52 volts. We can then tap directly off these lines and enter any house or building that wants lights without the necessity of installing any small transformers; in other words, we have by following out this method as flexible a system for incandescent lighting as the three-wire system now so much used for.

This method presents some remarkable features deserving the earnest study of those interested in such work, the principal being the great saving effected in copper over a two-wire system and the saving effected by the use of large transformers over small ones. This also presents a system which is flexible to an extreme degree in that, as the demands for lights increase and we reach the capacity of our transformer installed, we have but to put up another large transformer and we have another centre of distribution to cover the same area, or, if lights are wanted beyond a reasonable distance from our first transformer, by the installation of a second at this further point, we shall have very little loss in transmitting the current to it over the primary wire at 1,000 volts, so that we are ready to take a contract with any and every householder and furnish him with light at a price which shall be reasonable and which will prove as beneficial to the user as to the plant. It will be seen at once that this is one of the great features of such an installation. It is not necessary to skip anything, but to reach out and get all the business that there is in the whole town, and if this is done, I think I can safely assure the payment of a handsome dividend on the investment.

Application will be made to the Dominion Parliament by the Plate Glass and Boiler Insurance Co., of London, Ont., for power to insure against loss of life or injury to person of engineers or firemen in charge of steam boilers.

ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.

By Nikola Tesla.

(Continued.)

In this experiment the potential difference at the terminals of the lamps varies in sign thoeretically three to four million times a second. The ends of the filaments are correspondingly electrified, and the gas in bulbs is violently agitated and a large portion of the supplied energy is thus converted into heat. In the non exhausted bulb, there being a few million times more gas molecules than in the exhausted one, the bombardment, which is most violent at the ends of the filament, in the neck of the bulb, consumes a large portion of the energy without producing any visible effect. The reason is that, there being many molecules, the bombardment is quantitatively considerable, but the individual impacts are not very violent, as the speeds of the molecules are comparatively small owing to the small free path. In the exhausted bulb, on the contrary, the speeds are very great, and the individual impacts are violent and therefore better adapted to produce a visible effect. Besides, the convection of heat is greater in the former bulb. In both the bulbs the current traversing the filaments is very small, incomparably smaller than that which they require on an ordinary low-frequency circuit. The potential difference, however, at the ends of the filaments is very great and might be possibly 20,000 volts or more if the filaments were straight and their ends far apart. In the ordinary lamp a spark generally occurs between the ends of the filament or between the platinum wires outside, before such a difference of potential can be reached.

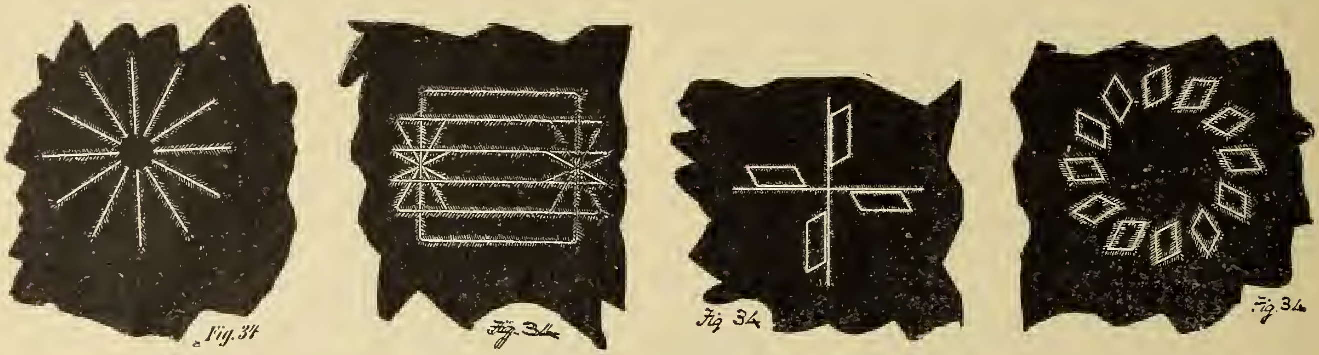
It might be objected, in the experiment before shown, that, the lamps being in multiple arc, the exausted lamp might take a much larger current, and that the effect observed might not be exactly attributable to the action of the gas in the bulbs. Such objections will lose much weight if I connect the lamps in series with the same result. When this is done, and the discharges are directed through the filaments, it is again noted that the filament in the none-exhausted bulb, l_1, remains dark, while that in the exhausted one, l, glows even more intensely than under its normal conditions of working, Fig. 22b. According to general ideas, the current through the filaments should now be the same, were it not modified by the presence of the gas around the filaments.

At this juncture I may point out another interesting feature, which illustrates the effect of the rate of change of potential of the currents. I will leave the two lamps connected in series to the bars B, B_1, as in the previous experiment, Fig. 22b, but will presently reduce considerably the frequency of the currents, which was excessive in the experiment just shown. This I may do by inserting a self-induction coil in the path of the discharges, or by augmenting the capacity of the condensers. When I now pass these low frequency discharges through the lamps, the exhausted lamp, l, again is as bright as before, but it is noted also that the non exhausted lamp, l_1, glows, though not quite as intensely as the other. Reducing the current through the lamp, I may bring the filament in the latter lamp to redness, and though the the filament in the exhausted lamp l, is bright, Fig. 22c, the degree of its incandescence is much smaller than in Fig. 22b, when the currents were of a much higher frequency.

In these experiments the gas acts in two opposite ways in determining the degree of the incandescence of the filaments; that is, by convection and bombardment. The higher the frequency and potential of the currents, the more important becomes the bombardment. The convection, on the contrary, should be the smaller, the higher the frequency. When the currents are steady, there is practically no bombardment, and convection may therefore with such currents also considerably modify the degree of incandescence and produce results similar to those just before shown. Thus, if two lamps exactly alike, one exhausted and one not exhausted, are connected in multiple arc or series to a direct current machine, the filament in the non-exhausted lamp will require a considerably greater current to be rendered incandescent. This result is entirely due to convection, and the effect is the more prominent the thinner the filament. Prof. Ayrton and Mr. Kilgour some time ago published quantitative results concerning the thermal emissivity by radiation and convection, in which the effect of thin wires was clearly shown. This effect may be strikingly illustrated by preparing a number of small, short glass tubes, each containing through its axis the thinnest obtainable platinum wire. If these tubes be highly exhausted, a number of them may be connected in multiple arc to a direct current machine, and all of the wires may be kept at incandescence with a smaller current than that required to render incandescent a single one of the wires if the tube be not exhausted. Could the tubes be so highly exhausted that convection would be nil, then the relative amounts of heat given off by convection and radiation could be determined without the difficulties attending thermal quantitative measurements. If a source of electric impulses of high frequency and very high potential is employed, a still greater number of the tubes may be taken and the wires rendered incandescent by a current not capable of warming preceptibly a wire of the same size immersed in air at ordinary pressure, and conveying the energy to all of them.

I may here describe a result which is still more interesting, and to which I have been led by the observation of these phenomena. I noted that small differences in the density of the air produced a considerable difference in the degree of incandescence of the wires, and I thought that, since in a tube, through which a luminous discharge is passed, the gas is generally not of uniform density, a very thin wire contained in the tube might be rendered incandescent at certain places of smaller density of the gas, while it would remain dark at the places of greater density, where the convection would be greater and the bombardment less intense. Accordingly a tube, t, was prepared, as illustrated in Fig. 23, which contained through the middle a very fine platinum wire w. The tube was exhausted to a moderate degree, and it was found that when attached to the terminal of a high frequency coil the platinum wire w would, indeed, become incandescent in patches, as illustrated in Fig 23. Later a number of these tubes with one or more wires were prepared, each showing this result. The effect was best noted when the striated discharge occurred in the tube, but was also produced when the striæ were not visible, showing that, even then, the gas in the tube was not of uniform density. The position of the striæ was generally such that the rarefactions corresponded to the places of incandescence or greater brightness on the wire w. But in a few instances it was noted that the bright spots on the wire were covered by the dense parts of the striated discharges as indicated by l in Fig. 23, though the effect was barely preceptible. This was explained in a plausible way by assuming that the convection was not widely different in the dense and rarefied places, and that the bombardment was greater on the dense places of the striated discharge. It is, in fact, often observed in bulbs that under certain conditions a thin wire is brought to higher incandescence when the air is not too highly rarefied. This is the case when the potential of the coil is not high enough for the vacuum, but the result may be attributed to many different causes. In all cases this curious phenomenon of incandescence disappears when the tube, or rather wire, acquires throughout a uniform temperature.

Disregarding now the modifying effect of convection, there are then two distinct causes which determine the incandescence of a wire or filament with varying currents; that is, conduction current and bombardment. With steady currents we have to deal only with the former of these two causes, and the heating effect is a minimum, since the resistance is least to steady flow. When the current is a varying one, the resistance is greater, and hence the heating effect is increased. Thus, if the rate of change of the current is very great, the resistance may increase to such an extent that the filament is brought to incandescence with inappreciable currents; and we are able to take a short and thick block of carbon or other material and bring it to bright incandescence with a current incomparably smaller than that required to bring to the same degree of incandescence an ordinary thin lamp filament with a steady or low frequency current. This result is important, and illustrates how rapidly our views on these subjects are changing and how quickly our field of knowledge is extending. In the art of incandescent lighting, to view this result in one aspect only, it has been commonly considered as an essential requirement for practical success that the lamp filament should be thin and of high resistance. But now we know that the resistance to the steady flow of the filament does not mean anything; the filament might as well be short and thick; for if it be immersed in rarefied gas it will become incandescent by the passage of a small current. It all depends on the frequency and potential of the currents. We may conclude from this that it would be of advantage, so far as the lamp is considered, to employ high frequencies for lighting, as they allow the use of short and thick filaments and smaller currents.



SPOKE WHEEL. DRUM WINDING. ALTERNATE MOTOR WINDING. RING WINDING.

SOME OF THE DESIGNS PRODUCED BY INTERMITTENT DISCHARGES.

If a wire or filament be immersed in a homogeneous medium, all the heating is due to true conduction current; but if it be inclosed in an exhausted vessel, the conditions are entirely different. Here the gas begins to act, and the heating effect of the conduction current, as shown in many experiments, may be very small compared with that of the bombardment. This is especially the case if the circuit is not closed and the potentials, of course, very high. Suppose a fine filament inclosed in an exhausted vessel be connected with one of its ends to the terminal of a high tension coil, and with its other end to a large insulated plate. Though the circuit is not closed, the filament, as I have before shown, is brought to incandescence. If the frequency and potential be comparatively low, the filament is heated by the current passing *through* it. If the frequency and potential, and principally the latter, be increased, the insulated plate need be but very small, or may be done away with entirely; still the filament will become incandescent, practically all the heating being then due to the bombardment. A practical way of combining both the effects of conduction current and bombardment is illustrated in Fig. 24, in which an ordinary lamp is shown provided with a very thin filament which has one of the ends of the latter connected to a shade serving the purpose of the insulated plate, and the other end to the terminal of a high tension source. It should not be thought that only rarefied gas is an important factor in the heating of a conductor by varying currents, but gas at ordinary pressure may become important, if the potential difference and frequency of the currents is excessive. On this subject I have already stated that when a conductor is fused by a stroke of lightning the current through it may be exceedingly small, not even sufficient to heat the conductor perceptibly were the latter immersed in a homogeneous medium.

From the preceding it is clear that when a conductor of high resistance is connected to the terminals of a source of high frequency currents of high potential, there may occur considerable dissipation of energy, principally on the ends of the conductor, in consequence of the action of the gas surrounding the conductor. Owing to this, the current through a section of the conductor at a point midway between its ends may be much smaller than through a section near the ends. Furthermore, the current passes principally through the outer portions of the conductor, but this effect is to be distinguished from the skin effect as ordinarily interpreted, for the latter would or should occur also in a continuous incompressible medium. If a great many incandescent lamps are connected in series to a source of such currents, the lamps at the ends may burn brightly, whereas those in the middle may remain entirely dark. This is due principally to bombardment, as before stated. But even if the currents be steady, provided the difference of potential is very great, the lamps at the ends will burn more brightly than those in the middle. In such case there is no rhythmical bombardment and the result is produced entirely by leakage. This leakage or dissipation into space when the tension is high is considerable when incandescent lamps are used, and still more considerable with arcs, for the the latter act like flames. Generally, of course, the dissipation is much smaller with steady than with varying currents.

I have contrived an experiment which illustrates in an interesting manner the effect of lateral diffusion. If a very long tube is attached to the terminal of a high frequency coil, the luminosity is greatest near the terminal and falls off gradually toward the remote end. This is more marked if the tube is narrow.

A small tube about one-half inch in diameter and twelve inches long, Fig. 25, has one of its ends drawn out into a fine fibre f nearly three feet long. The tube is placed in a brass socket T which can be screwed on the terminal T_1 of the induction coil. The discharge passing through the tube first illuminates the bottom of the same, which is of comparatively large section; but through the long glass fibre the discharge cannot pass. But gradually the rarefied gas inside becomes warmed and more conducting, and the discharge spreads into the glass fibre. This spreading is so slow that it may take half a minute or more until the discharge has worked through up to the top of the glass fibre, then presenting the appearance of a strongly luminous thin thread. By adjusting the potential at the terminal the light may be made to travel upward at any speed. Once, however, the glass fibre is heated the discharge breaks through its entire length instantly. The interesting point to be noted is that, the higher the frequency of the currents, or in other words the greater relatively the lateral dissipation, at a slower rate may the light be made to propagate through the fibre. This experiment is best performed with a highly exhausted and freshly made tube. When the tube has been used for some time the experiment often fails. It is possible that the gradual and slow impairment of the vacuum is the cause. This slow propagation of the discharge through a very narrow glass tube corresponds exactly to the propagation of heat through a bar warmed at one end. The quicker the heat is carried away laterally the longer time it will take for the heat to warm the remote end. When the current of a low frequency coil is passed through the fibre from end to end, then the lateral dissipation is small, and the discharge instantly breaks through almost without exception.

After these experiments and observations, which have shown the importance of the discontinuity or atomic structure of the medium, and which will serve to explain, in a measure at least, the nature of the four kinds of light effects produceable with these currents, I may now give you an illustration of these effects. For the sake of interest I may do this in a manner which to many of you might be novel. You have seen before that we may now convey the electric vibration to a body by means of a single wire or conductor of any kind. Since the human frame is conducting I may convey the vibration through my body.

First, as in some previous experiments, I connect my body with one of the terminals of a high tension transformer, and take in my hand an exhausted bulb which contains a small carbon button mounted upon a platinum wire leading to the outside of the bulb, and the button is rendered incandescent as soon as the transformer is set to work (Fig. 26). I may place a conducting shade on the bulb which serves to intensify the action, but it is not necessary. Nor is it required that the button should be in con- through ducting connection with the hand through a wire leading the glass, for sufficient energy may be transmitted through the glass itself by inductive action to render the button incandescent.

Next I take a highly exhausted bulb containing a strongly phosphorescent body, above which is mounted a small plate of aluminum on a platinum wire leading to the outside, and the currents flowing through my body excite intense phosphorescence in the bulb, Fig. 27. Next again I take in my hand a simple exhausted tube, and in the same manner the gas inside the tube is rendered highly incandescent or phosphorescent, Fig. 28. Finally, I may take in my hand a wire—bare or covered with thick insulation, it is quite immaterial; the electric vibration is so intense as to cover the wire with a luminous film, Fig. 29.

A few words must now be devoted to each of these phenomena. In the first place, I will consider the incandescence of a button or of a solid in general, and dwell upon some facts which apply equally to all these phenomena. It was pointed out before that when a thin conductor, such as a lamp filament, for instance, is connected with one of its ends to the terminal of a transformer of high tension, the filament is brought to incandescence partly by a conduction current and partly by bombardment. The shorter and thicker the filament, the more important becomes the latter, and, finally reducing the filament to a mere button, all the heating must practically be attributed to the bombardment. So in the experiment before shown, the button is rendered incandescent by the rhythmical impact of freely movable small bodies in the bulb. These bodies may be the molecules of the residual gas, particles of dust or lumps torn from the electrode; whatever they are, it is certain that the heating of the button is essentially connected with the pressure of such freely movable particles, or of atomic matter in general in the bulb. The heating is the more intense the greater the number of impacts per second and the greater the energy of each impact. Yet the button would be heated also if it were connected to a source of steady potential. In such a case electricity would be carried away from the button by the freely movable carriers or particles flying about, and the quantity of electricity thus carried away might be sufficient to bring the button to incandescence by its passage through the latter. But the bombardment could not be of great importance in such case. For this reason it would require a comparatively very great supply of energy to the button to maintain it at incandescence with a steady potential. The higher the frequency of the electric impulses, the more economically can the button be maintained at incandescence. One of the chief reasons why this is so, is, I believe, that with impulses of very high frequency there is less exchange of the freely movable carriers around the electrode, and this means that in the bulb the heated matter is better confined to the neighborhood of the button. If a double bulb, as illustrated in Fig. 30, be made, comprising a large globe B and a small one b, each containing as usual a filament f mounted on platinum wire w and w, it is found, that if the filaments f f be exactly alike, it requires less energy to keep the filament in the globe b at a certain degree of incandescence than in the large globe, B. This is due to the confinement of the movable particles around the button. In this case, it is also ascertained, that the filament in the small globe b is less deteriorated when maintained a certain length of time at incandescence. This is a necessary consequence of the fact that the gas in the small bulb becomes strongly heated and therefore a very good conductor, and less work is then performed on the button, since the bombardment becomes less intense as the conductivity of the gas increases. In this construction, of course, the small bulb becomes very hot, and when it reaches an elevated temperature the convection and radiation on the outside increase. On another occasion, I have shown bulbs in which this drawback was largely avoided. In these instances a very small bulb, containing a refractory button, was mounted in a large globe, and the space between the walls of both was highly exhausted. The outer large globe remained comparatively cool in such constructions. When the large globe was on the pump and the vacuum between the walls maintained permanent by the continuous action of the pump, the outer globe would remain quite cold, while the button in the small bulb was kept at incandescence. But when the seal was made, and the button in the small bulb maintained incandescent some length of time, the large globe too would become warmed. From this I conjecture that if vacuous space (as Prof. Dewar finds) cannot convey heat, it is so merely in virtue of our rapid motion through space or, generally speaking, by the motion of the medium relatively to us, for a permanent condition could not be maintained without the medium being constantly renewed. A vaccum cannot, according to all evidence, be permanently maintained around a hot body.

In these constructions, before mentioned, the small bulb inside would, at least in the first stages, prevent all bombardment against the outer, large globe. It occurred to me then, to ascertain how a metal sieve would behave in this respect, and several bulbs, as illustrated in Fig. 31, were prepared for this purpose. In a globe b, was mounted a thin filament f (or button) upon a platinum wire w passing through a glass stem and leading to the outside of the globe. The filament f was surrounded by a metal sieve s. It was found in experiments with such bulbs that a sieve with wide meshes apparently did not in the slightest affect the bombardment against the globe b. When the vacuum was high, the shadow of the sieve was clearly projected against the globe, and the latter would get hot in a short while. In some bulbs the sieve was connected to a platinum wire sealed in the glass. When this wire was connected to the outer terminal of the induction coil (the E. M. F. being kept low in this case) or to an insulated plate, the bombardment against the outer globe b was diminished. By taking a sieve with fine meshes the bombardment against the globe b was diminished, but even then if the exhaustion was carried very far, and when the potential of the transformer was very high, the globe b would be bombarded and heated quickly, though no shadow of the sieve was visible owing to the smallness of the meshes. But a glass tube or other continuous body mounted so as to surround the filament, did entirely cut off the bombardment and for a while the outer globe b would remain perfectly cold. Of course when the glass tube was sufficiently heated, the bombardment against the outer globe could be noted at once. The experiments with these bulbs seemed to show that the speeds of the projected molecules or particles must be considerable (though quite insignificant when compared with that of light), otherwise it would be difficult to understand how they could traverse a fine metal sieve without being affected, unless it were found that such small particles or atoms cannot be acted upon directly at measurable distances. In regard to the speed of the projected atoms, Lord Kelvin has recently estimated it at about one kilometre a second or thereabouts in an ordinary Crookes bulb. As the potentials obtainable with a disruptive discharge coil are much higher than with ordinary coils, the speeds must, of course, be much greater when the bulbs are lighted from such a coil. Assuming the speed to be as high as five kilometres and uniform through the whole trajectory, as it should be in a very highly exhausted vessel, then if the alternate electrifications of the electrode would be of a frequency of five million, the greatest distance a particle could get away from the electrode would be one millimetre, and if it could be acted upon directly at that distance, the exchange of electrode matter or of the atoms would be very slow, and there would be practically no bombardment against the bulb. This at least should be so, if the action of an electrode upon the atoms of the residual gas would be such as upon electrified bodies which we can perceive. A hot body inclosed in an exhausted bulb produces always atomatic bombardment, but a hot body has no definite rhythm, for its molecules perform vibrations of all kinds.

If a bulb containing a button or filament be exhausted as high as is possible with the greatest care and by the use of the best artifices, it is often observed that the discharge cannot, at first, break through, but after some time, probably in consequence of some changes within the bulb, the discharge finally passes through and the button is rendered incandescent. In fact, it appears that the higher the degree of exhaustion, the easier is the incandescence produced. There seems to be no other causes to which the incandescence might be attributed in such case, except to the bombardment or similar action of the residual gas or of particles of matter in general. But if the bulb be exhausted with the greatest care, can these play an important part? Assume the vacuum in the bulb to be tolerably perfect, the great interest then centres in the question: Is the medium which pervades all space continuous or atomic? If atomic then the heating of a conducting button or filament in an exhausted vessel might be due largely to etherbombardment, and then the heating of a conductor in general through which currents of high frequency or high potential are passed must be modified by the behavior of such medium; then also the skin effect, the apparent increase of the ohmic resistance, etc., admit, partially, at least, of a different explanation.

It is certainly more in accordance with many phenomena observed with high-frequency currents to hold that all space is pervaded with free atoms, rather than to assume that it is devoid of these, and dark and cold, for so it must be, filled with a continuous medium, since in such there can be neither heat nor light. Is, then, energy transmitted by independent carriers or by the vibration of a continuous medium? This important question is by no means as yet positively answered. But most of the effects which are here considered, especially the light effects, incandescence, phosporescence, involve or the presence of free atoms and would be impossible without these.

(To be Continued.)

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THERE are 546 students enrolled on the books of the Toronto Technical School. The accommodation afforded by the present building has been found to be very inadequate to the requirements. A committee has therefore been appointed to petition the City Council for increased accommodation.

IT is strange notwithstanding the fact is now known that a fan motor will keep the frost off a window that there should not be more of them in use. To any store having incandescent light a fan surely is a good investment, as it can be used in winter to keep the frost off the windows and in summer to assist the ventilation of the apartments.

IN view of the lack of agreement between various County Judges as to whether gas mains in the public streets are subject to taxation as real property, the Ontario Legislature has been petitioned by several of the municipalities to decide the question by legislation. Sir Oliver Mowat has expressed the opinion that the mains should be taxed where it can be shown that the Company is paying a dividend. The Government has promised to consider the matter.

TO many seekers after electrical knowledge the announcement has been received with regret that the course of lectures announced to be delivered by Prof. Cox at McGill University will not take place. Purchasers of tickets for the course of lectures have been notified to this effect and requested to call and have their money refunded. A rumor is current to the effect that the faculty of McGill do not wish the professors to lecture to other than regular students of the University.

A FEW days ago there appeared a letter in one of our daily papers under the caption, "Something Wanted in Toronto." The letter went on to state that repair shops for electrical apparatus, where duplicate parts of motors could be kept was a thing much needed in Toronto. It is known to some that there are such places in Toronto, where everything of the sort can be obtained, but the proprietors of these establishments do not avail themselves of the advertising columns of the press, consequently work they might get is sent away to other places to be done.

THE Hon. Mackenzie Bowell, who recently returned from Australia, which he visited with the object of developing our trade relations, indicated in his speech before the Manufacturers' Association, many lines of trade which are being supplied by the manufacturers of the United States, with whom the manufacturers of Canada might profitably enter into competition. Among other information, Mr. Bowell stated that it should be possible for Canadian manufacturers of electrical machinery and appliances to find a considerable market in Australia for these lines of production. No doubt the hint will not be thrown away on this class of manufacturers, who are undoubtedly among the most wide-awake and enterprising in the Dominion

A PETITION has been presented to the Ontario Legislature by Mr. Bronson, at the request of certain steam users of the City of Ottawa, praying that the Engineers' Act may be so amended that engineers operating engines of 15 horse power and over must hold certificates as a proof of their competency. A similar amendment to the existing law is to be asked for by the Executive of the C. A. S. E. This we regard as a step in the right direction, and one which should receive the support of all interested in the endeavor to bring about a higher standard of education and efficiency on the part of engineers.

IT was pointed out in the ELECTRICAL NEWS some time ago, that the inauguration of rapid street railway transit in Toronto would have a tendency to induce business men and others employed down town to lunch at home instead of at the restaurants. The fact that correspondents of the daily papers are complaining that standing room only can be procured on cars on certain lines during lunch hour is a proof of the correctness of the assumption. It is safe to say that the railway company's business might be largely increased by a reduction in the price of tickets used between the hours of noon and two o'clock p. m.

LARGE incandescent lamps are beginning to make their appearance in several buildings in Montreal, 200 and 300 c. p. lamps being used. The manufacturers of these lamps claim a higher efficiency than the ordinary 16 c. p. lamps. If this claim is borne out the large lamps will no doubt become popular for interior illumination of large areas, such as stores, halls, etc. At the same time, however, it must be borne in mind that the color of the light is still of a yellow hue and the distinguishing colours of silks and other goods, as for example certain shades of green as compared with blue, cannot be told by it with the precision that they can by the arc light.

THE absurd method of giving lights by contract is still followed by a few companies, and it would surprise some electrical people to know that this is even done in Montreal where they might suppose the electric people would know better. What is to hinder a man, contracting for a certain number of 16 c. p. lights from buying a few 32's or 50's if he choose and screwing them into his sockets in place of the 16's as often as he sees fit? The inspectors (if there are any) certainly will not make their rounds and examine the lamps after 6 o'clock at night, and this is just the time when such exchanges would be made—in fact it *is* done, and the cases are not few either.

A GREAT deal of interest has been aroused by the offer of the Metropolitan Traction Company, of New York, to give a prize of $50,000 to the inventor of a practical street railway system to take the place of the trolley and cable systems. The offer has apparently been made in good faith, as evidenced by the fact that the judgment of the merits of the inventions which may be submitted is placed entirely outside of the Company's hands. The offer of so large an amount of money bears testimony to the value of the trolley system. We are in accord with the opinion of the New York Electrical Review, which states that the man who invents such a system as the Metropolitan specifies can get $1,000,000 for it just as easily as he can get $50,000.

THE discussion which for some time past has been going on in these columns with regard to the relative advantages of high versus slow speed engines for electric railway work, might we think be profitably supplemented by one in which proper consideration would be given to appliances for bringing to a sudden stop electric cars while travelling at a high rate of speed. This is one of the most important subjects to which attention can be called at the present time, in view of the demand for rapid transit in cities, the danger to human life which attends compliance with this demand, and the serious financial losses to which street railway companies have recently been subjected by adverse decisions of the Courts in actions for damages. The question as to what should be the limit of speed for electric cars and a suitable means of determining the speed at which cars are being run might very properly form a feature of the discussion. We invite an expression of views from our readers on this important subject.

The difficulty which we referred to in our last issue as existing in Truro, N. S., between the telephone and electric light companies has, we are pleased to note, been satisfactorily arranged, the contestants like sensible people, having decided to call the fight off rather than demonstrate which has the longer purse. The local electric light company proposed to give its patrons a free telephone system and had actually erected a plant with this view. The Nova Scotia Telephone Company then took steps for the prompt instalment of an electric light plant with such a big cut in rates that there was nothing left in the business and at the same time boldly announced that if necessary for the protection of their business, they would do the same in every town in the province. The lighting company recognized the inevitable and withdrew before it was too late. Such a fight would have been worse than useless, absolutely senseless, as both sides would have been hard hit financially, two legitimate lines of business would have been destroyed, and no one would have benefitted permanently. Of course the trouble was the culmination of recurring differences over trivial matters. Electric companies occupying the same field, but in no sense rivals, may and should be mutually helpful in working together harmoniously. This little far away scrimmage has an important moral which it were advantageous and profitable to be generally recognized and regarded.

THE attention of superintendents of electric lighting stations was directed in these columns a few months ago to the necessity of frequently examining current meters, and thereby satisfying themselves that they were in proper working condition. The fact was mentioned that one cause of inefficiency was found to be the disposition of spiders to weave their webs about the mechanism of the meter in such a way as to prevent it from properly recording the current. A case of this kind has just come to light in St. Thomas, Ont. The meter in one of the stores in that city, when examined, showed no change from the preceding month, notwithstanding that the regular amount of light had been used. The experiment was tried of increasing the number of lamps used, in the belief that the small amount of current previously employed was not sufficient to operate the mechanism of the meter. When it was discovered that the increased current consumed had no effect upon the meter, an examination was made, and it was found that the industrious spider was at the bottom of the difficulty.

THE question as to who should be liable for the cost of protecting railway crossings in cases where steam railroads are crossed by electric street cars within the boundaries of city municipalities, has been argued within the last few days before the Railway Committee of the Privy Council at Ottawa, in connection with the dispute on this point which has arisen between the Grand Trunk and Canadian Pacific Railway Companies and the Toronto Street Railway Company, with reference to the King street east crossing. Mr. B. B. Osler, counsel for the Toronto Street Railway Company, raised the novel contention that an electric street railway was a highway for the carrying of passengers, on the same principle as if busses or carriages were used; that the right to use the highway for this purpose was granted to them under the General Public Act, this right being recognized by the Provinces of Ontario and Quebec. From this contention he argued that the question was one beyond the jurisdiction of the Committee, and one which should be submitted to the Supreme Court for final decision. The Committee decided to hear the arguments in the case, and reserved its judgment as to the question of jurisdiction.

Several city municipalities are considering the advisability of purchasing the necessary electric plant and doing their own lighting. The impression has seemingly got abroad that it would be possible to get cheaper light by this method than by contract with a private company. The ratepayers of the City of London apparently thought otherwise, and voted down a by-law submitted to them recently by the City Council to authorize the appropriation of money for the purchase of an electric plant. The cities of Hamilton, Woodstock and Ottawa are now considering the question. The last named city has obtained offers from several manufacturing companies for the supply of the necessary machinery for a 500 light plant. The estimated cost of such a plant, exclusive of poles, is about $200,000. The interest and sinking fund on this amount would be about $12,000 per year. The city now pays, under contract, $26,000 a year for lighting. This would leave $14,000 per year with which to operate the plant, and the aldermen who have been appointed to deal with the subject appear to think that a large proportion of this amount could be saved. It seems questionable, however, whether they are at present in possession of the information necessary to enable them to arrive at a conclusion on this point, and therefore it may not be out of place for us to submit the estimate of one of the most experienced station managers in Canada, as to the cost of operating at Ottawa a 500 light plant. It is as follows:

	Per Year.
Salary of Superintendent	$ 1,500 00
Two dynamo tenders and one oiler and cleaner, 3 men at $500	1,500 00
Seven trimmers at $500	3,500 00
Three patrol men at $500	1,500 00
One outside repairer with horse and wagon	1,000 00
One lamp repairer in station	500 00
Carbons for 500 lamps	5,470 00
Wear and tear and repair	5,000 00
Oil, &c	250 00
Insurance	500 00
Globes	850 00
Sundries, tools, &c	500 00
	$22,070 00
	14,000 00
Loss to municipality	$ 8,070 00

It would be well for municipal officials and the daily press to obtain their data from impartial sources. Many of the estimates of cost published in the daily papers—the Hamilton *Herald* for example—are very wide of the mark; and we surmise were either furnished by the representative of an electric manufacturing company desirous of securing an order, or a person on the look-out for a position in the city's employ.

NOTES FOR ENGINEERS.

If steam boilers are required to carry safely a working pressure of 160 pounds per square inch, and the quantity of steam is so great that boilers with furnaces as large as a man can handle, even if fitted with shaking grates, should be used, what style of boiler would be most serviceable?

The ordinary make of horizontal tubular boiler of 72 inches diameter and 16 feet in length would take a furnace as large as a man can well manage.

What thickness of plates would be necessary, allowing a factor of safety of 5, and making butt joints with double straps, giving 80 per cent. of solid plate as the strength of joint. The plate to have a tensile strength of 60,000 pounds per square inch?

The problem is, having the diameter of boiler and the strength of joint and of plate given, and the pressure and facts of safety, to find the thickness. The inside diameter of the shell in inches at the largest of the rings, multiplied by the working pressure, will form one side of an equation. The other side is found by taking the tensile strength per square inch multiplied by two, and divided by the factor of safety and multiplied by the fraction representing the percentage of strength of joint; and by whatever number will make it equal the figures found for the first side of the equation. This last number is the required thickness of plate, and is found by dividing the first side of the equation by the quantity found by the process stated.

In the example, the boiler is to be about 72 inches diameter, and 72 may be used as the internal diameter. The pressure is to be 160, therefore $160 \times 72 = 11520$ pounds per square inch is the strain put upon the boiler plate by the steam pressure. To resist this there are two thicknesses of metal, one on each side of the boiler. The metal is 60,000 pounds per square inch; multiplied by 2, it is 120,000; but it is to be strained to only *one-fifth*, therefore, 120,000 divided by $5 = 24{,}000$. Then the joint is 80% of the solid metal, and as 80% is eight-tenths, the 24,000 must be divided by ten and multiplied by eight—that gives 19,200. If the plates were *one* inch thick it would give a strength of 19,200 pounds, and by the first part of the calculation, 11,520 pounds was all that was required. Therefore, 11,520 divided by 19,200 gives the fraction of an inch which would represent the thickness of plate. $\frac{11520}{19200}$ reduced to its lowest terms is three-fifths, and the plate would require to be three-fifths of an inch thick or nearly five-eighths of an inch. This is too heavy to have exposed to the action of the fire, and it may at once be settled that for steam pressure of 160 pounds per square inch and over, and where large quantities of steam are required the horizontal tubular boiler is unsuitable.

The same line of reasoning will show that for internally fired boilers the outer shells require to be so large in diameter, and to be made of such very thick plate, that it is desirable to look out for some other style.

Hitherto most marine boilers carrying 160 lbs. steam pressure have been made with internal furnaces and enormously heavy shells. At the present time there is a demand for something better, and for higher steam pressure. This has led some to adopt the water tube boiler, and the old dispute as to whether tubes should contain water or fire in a steam boiler is revived with all appearances in favor of "water" being victorious, owing to the demand for increased pressure.

A water tube boiler made for a Torpedo Destroyer boat for the British Navy, when filled with water ready for use, weighed a little over six tons.

Steam was got up to working pressure from cold water in twenty-two minutes, and boiler made steam so rapidly that over 12,000 pounds of water per hour were required to keep up the supply. This shows that it is possible to construct a steam boiler safe for the high pressures in use, (180 to 200 lbs. per square inch) which, when ready for steam, will weigh less than seven tons, and will require no brick setting, and yet give four hundred horse power according to United States Government standard.

He is something for electrical engineers to investigate. If such boilers can be made and used in a war vessel, why can they not be got for an electric station?

ERRATA.

An error inadvertently crept into the paper published in the February number of the NEWS on the "T. H. Dynamo," by Mr. James Burnett. In second column, "the two leading (top brushes) are moved about three times as *fast* as the two following (side brushes)," the word "slow" should be substituted for the word "fast".

A committee of the Hamilton City Council has been appointed to inquire into the cost of electric machinery and the expense of operating the same. This information is required to enable the Council to decide whether or not it would be profitable for the City to undertake to do its own lighting.

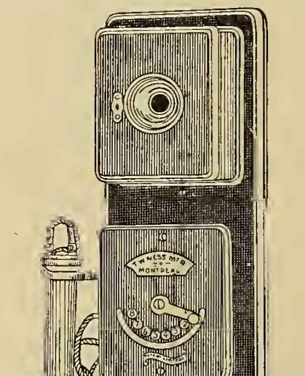
The "Montreal Junior Electric Club" has been organized, and has had several interesting meetings. The officers of the club are: E. W. Sayer, president; William Sutton, vice-president; H. Street, Treasurer; H. O. J. Overton, Secretary, 19 Burnside street. At the last meeting of the club interesting papers were read on "Electric Bells and Batteries," by Mr. Wm. Smith, and "The Discovery and Early Experiments of Electricity and Magnetism," by Mr. E. W. Sayer. The meeting was held at No. 6 Richmond avenue.

MOONLIGHT SCHEDULE FOR MARCH.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1......	P. M. 6.00	A.M. 4.40	10.40
2......	" 6.20	" 5.00	10.40
3......	" 6.20	" 5.00	10.40
4......	" 6 20	" 5.00	10.40
5......	" 6.20	" 5.00	10.40
6......	" 6.20	" 5.00	10.40
7......	" 6.20	" 5.00	10.40
8	" 6.20	" 5.00	10.40
9......	" 6.20	" 5.00	10.40
10......	" 6.40	" 5.00	10.20
11......	" 8.10	" 5.00	8.50
12......	" 9.00	" 5.00	8.00
13......	" 10.00	" 5.00	7.00
14......	" 10.40	" 5.00	6.20
15......	" 11.20	" 5.00	5.40
16......	" 12.00	" 5.00	5.00
17......	....	" 5.00	3.50
18......	A.M. 1.10	....	
19......	No light.	No light.	....
20	No light.	No light.	....
21......	No light.	No light.	....
22......	No light.	No light.	....
23......	P. M. 6.10	P. M. 9.10	3.00
24......	" 6.10	" 10.20	4.10
25	" 6.10	" 11.00	4.50
26......	" 6.10	" 12.00	5.50
27......	" 6.20	A. M. 12.30	6.10
28......	" 6.20	" 1.00	6.40
29	" 6.20	" 1.30	7.10
30......	" 6.20	" 2.40	8.20
31......	" 6.20	" 3.50	9.30
		Total,	206.40

AN AUTOMATIC WAREHOUSE TELEPHONE.

A new warehouse telephone has just been placed upon the market by the well-known telephone and electrical manufacturing firm of T. W. Ness & Co., Montreal. The special feature of this new instrument, which is the invention of Mr. T. W. Ness, and has been patented in Canada, the United States and other countries, is an automatic switch return, by means of which the switch is brought back automatically to its normal point after conversation is finished. Those who are familiar with the old system, in which connection is made by inserting a plug in a socket corresponding with the line desired, which plug requires to be withdrawn after through talking, but is constantly overlooked, or the old style of switch, which requires to be returned by hand to its normal point, will at once see and appreciate the value of this new invention.


T. W. NESS MFG MONTREAL

NESS TELEPHONE.

The automatic switch, receiver hook and bell are combined in the centre box. This automatic system is particularly suitable for connecting the different departments of factories, warehouses, offices, banks, colleges, etc., and it will be observed that no central office for making the different connections is required. Each instrument in a series has switch points corresponding or connecting with each of the other instruments, so that any one telephone can call up, or be called up, by any other by simply turning the switch lever around to the point corresponding with the instrument desired, and at the same time "ringing up," which is done by pressing the lever down upon the outer ring, shown below the switch points; this causes the bell of the instrument required to ring. After conversation is finished, the hanging up of the receiver causes the switch lever to return automatically to its own point, thus leaving the telephone in position to be called up by any other instrument. When desired, the instruments can be so arranged that only certain ones in a series can call up certain others, instead of having the whole system interchangeable. In ringing up, only the bell of the instrument required sounds, so none of the others are disturbed, and conversation is at the same time private. In a series of, say, eight instruments, 1 and 3, 2 and 4, 5 and 6, might converse at the same time, without interfering with one another.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of the various Associations are requested to forward to us matter for publication in this Department not later than the 20th of each month.

MONTREAL ASSOCIATION NO. 1.

In a letter dated the 8th of February, addressed to the officers and members of the above Association, Mr. Joseph G. Robertson, the President, announces his intention of resigning office, giving as his reason the lack of interest manifested by a large number of the membership in the work of the Association.

KINGSTON ASSOCIATION NO. 10.

We are pleased to learn from Mr. H. Hoppins, the treasurer of the above Association, that the membership is steadily increasing, the meetings are well attended, and the discussions animated and interesting. This information is very satisfactory as far as it goes, but it would interest many of our readers to learn more in detail what the animated and interested discussions are about.

HAMILTON ASSOCIATION NO. 2.

HAMILTON Feb. 20th, 1894.

Editor ELECTRICAL NEWS.

The two last meetings of the above Association were ones of no small interest. At the regular meeting on Feb. 2nd, Mr. S. H. Milson was initiated and other business of importance transacted.

At the instruction meeting held on Feb. 17th, a very interesting time was spent, the subject for discussion being the most economical and best methods of handling a steam plant. The first question asked was what is the best and most economical boiler to be employed, and was discussed at some length. The water tube boiler was spoke of as being a good steam generator and a good many things were said about its form of construction.

Other questions asked were regarding the best style of grate bars to be employed and whether it is necessary to have different styles of grate bars for different kinds of coal; many instructive points were brought out under this head.

We find that this system of having instruction meetings is the means of getting all present interested, as is indicated by the number of those who take part in the discussions.

Another important matter which was dealt with at the last two meetings, and which we are sure from past experience a great many members of sister lodges will hear of with pleasure, was concerning our annual dinner, which is to be held on the evening of March 22nd at the Commercial Hotel. An extraordinary good time is promised to all who shall be present on that evening.

WM. NORRIS,
Rec.-Secretary.

OTTAWA ASSOCIATION NO. 7.

ditor ELECTRICAL NEWS.

SIR,—At the last regular meeting we were favored with the unexpected presence of Bros. Thomas Stewart, of Arnprior, and F. M. Donaldson, of Toronto, who gave very interesting addresses on the construction and efficiency of steam boilers, accompanied with blackboard examples.

The steam dome received its fair share of attention, and particularly the misleading idea that it is an absolute necessity to have one on all boilers in order to obtain what is termed dry steam. It was very clearly demonstrated that by the use of a dry pipe extending lengthwise in a well designed boiler, a better quality with more uniformity could be obtained.

The next thing considered was the weakness due to the cutting of the plate for the passage of steam to the steam dome, this hole being sometimes made the full diameter of the dome. Even if it were smaller and re-inforced it is very doubtful if the strength obtained would be sufficient to overcome the weakness caused by the cutting. Another objection to the steam dome was that the part of shell within was in a balanced condition so far as steam was concerned—the pressure being the same below as above it, consequently the strains on the other parts of the shell have a tendency to flatten that part under the dome, and as it was not so effectively resisted, the joints were subjected to very trying strains. This interesting subject brought out remarks on the abuse to steam boilers by being in charge of incompetent men.

The boiler explosion at Byers' Corners furnished a good theme for discussion, and particular attention was drawn to the duties and liability of the working engineer, that of using the boiler carefully, of keeping it clean and examining it at such intervals as the nature of the water in use requires.

One common practice which was very much condemned is the overloading of safety valves—"to keep them from leaking" as the engineer (?), says and entire dependence on the steam gauge. One member here cited a case which came under his notice of a connection from boiler to steam gauge, including a syphon next to gauge, being exposed to a stiff current of air from the engine room window sufficiently cold to freeze the water from condensation in the pipe, consequently making the steam gauge useless, for it would not indicate the varying pressure in the boiler. Fortunately in that case the safety valve was in good working order; but any one can imagine the result if the safety valve had been overloaded or stuck to its seat. The speaker's opinion was that such was the cause of the last fatal explosion (except some expert brings forth the low water theory) as it was a portable saw mill, and as a general rule such mills are not very well protected from inclement weather, and the majority of men in charge of such portable boilers are using the safety valve lever as a tool rack.

After some appropriate remarks on the tensile strength of iron and steel and the bursting and safe working pressure of boilers, the President gave the first of a series of lessons on decimal fractions and decimal numerations. In opening his remarks he said that owing to numerous calculations relative to the steam engine decimals were absolutely necessary, the knowledge of their use and relation to ordinary fractions was dependent on their position to the unit, and that the decimal point was the most important in all calculations. After showing how to reduce ordinary fractions into decimals together with the signs and terms used universally, he announced that at the next meeting the first four rules of arithmetic would be the subjects taken.

Before the meeting adjourned a vote of thanks was tendered Bros. Donaldson and Stewart for their very instructive addresses.

PROGRESS.

TORONTO ASSOCIATION NO. 1.

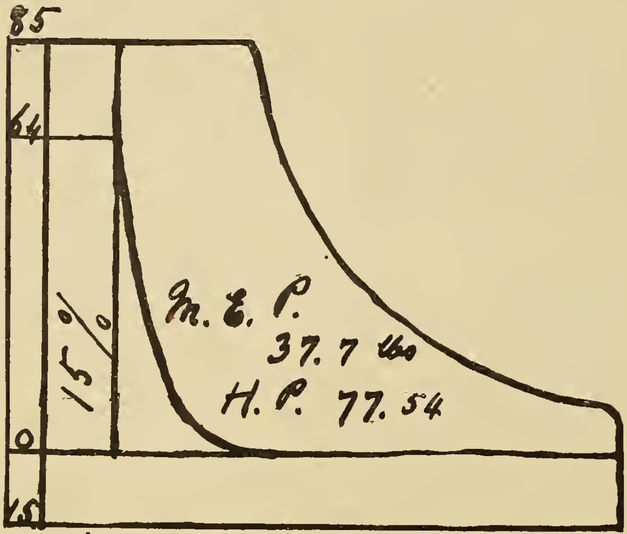
The membership has increased rapidly of late. There has not been a meeting for a long time past without one, two or three members being initiated, and propositions for membership are being continually received.

The meeting of Jan. 26th was an exceptionally good one with a numerous attendance, induced no doubt by the rumors of a war of arguments between the believers in high speed engines and the lovers of the slow speed engine.

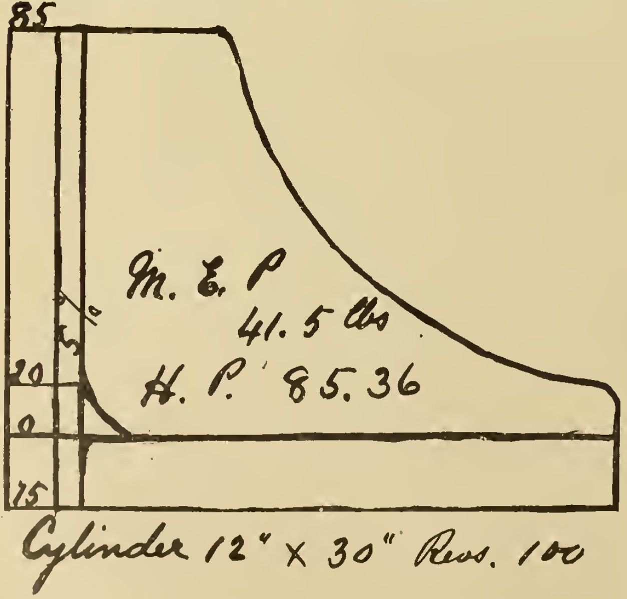
After routine business had been hastily disposed of, the doors were opened to the public.

Bro. Chas. Heale was the first to take the floor in favor of high speed engines. He said the subject of high speed in stationary engines had been well thought out by constructive and designing engineers. The principles of steam engine economy were well understood by Watt a century ago, and yet it is only within the last few years that we have got nearer to a satisfactory solution of the problem. Watt found that the great source of loss was the heating and cooling of the cylinder at each stroke. To remedy this defect he insulated the metal, attached a separate condenser, shortened the stroke, increased the number of revolutions, and in fact made a high speed engine. The principles that must govern, the engineer to-day said Bro. Heale may be summarized thus :—The steam must enter the cylinder at the highest admissable pressure ; all exterior waste of heat must be prevented as far as possible, and the much greater waste that occurs within the engine by cylinder condensation and re-evaporation must be checked as far as practicable ; this could best be done by a high speed engine. The greatest amount of work must be done with due regard to the preceding conditions ; this compelled the driving of the engine at the high highest safe speed and adoption of the highest economical M. E. P. The two first conditions gave maximum efficiency of engine. In additions to these requisites the designers and builders of engines were compelled by some modern industries to meet demands more imperative than in others ; the chief of these are great regularity of speed, ease and cheapness of connecting them to their work, simplicity, compactness, rigidity, strength and durability. In the attempt to meet these demands the present high speed engine has taken shape. When the above qualities are blended in a high speed engine all difficulty of operation vanishes ; high speed being a great revealer of defects, it follows necessarily that everything about the machine must be in first class working order, everything balanced and fitted up with the best workmanship ; on the other hand slowly revolving machinery does not easily show defects, nor does it receive the same attention as the high speed. There is only one standard of work permissible in the high speed engine, and that is "perfection"—when it is otherwise the machine is a failure. Objections were made to the high speed engines, that on account of their great speed they were more liable to accidents, but after reading in the different mechanical papers so many accounts of fly wheel accidents charged up to the slow speed engine, he had concluded that the high speed engine was much safer to be with. Opponents of high speed lay great stress on the losses by clearance, entirely ignoring the advantages of compression in preventing cylinder condensation and the fact that by giving an engine a great speed the time allowed for cooling down on the return stroke is reduced, and the cylinder practically kept as Watt said it should be, viz., as hot as the steam that entered it ; whereas the slow speed engine has its cylinder walls exposed to the atmosphere five or six times longer during a stroke than the high speed, therefore the losses from condensation must be greater in the slow speed. In addition to the advantages already enumerated, Bro. Heale added the great saving in space and foundations, lighter fly wheels, consequently less friction and immunity from bursting, the absence of belting and counter shafting, and when belts are required, short parallel ones with large contact can be used. High efficiency under great variations of load and steam pressure is a characteristic of the high speed engine owing to the action of the governor increasing compression with increasing expansion, and decreasing compression with decreasing expansion, thus utilizing the heat of compression to check cylinder condensation. Bro. Heale then gave some illustrations on the blackboard of the percentages of variations between friction and full load, also the opinions of several eminent authorities on steam engineering to convince his hearers that his arguments in favor of high speed engines were correct.

Bro. Wickens then took the floor in defence of the slow speed engine and said : I will first answer some of the statements made by Bro. Heale. I think as far as economy in the use of steam is concerned we cannot do better than to look at some of James Watts' old Cornish pumping engines. Some of those engines have been working continuously for the last 80 or 90 years setting an example of economy (120,000,000 foot pounds per 100 pounds of coal) that later engine builders have very rarely reached and still more seldom exceeded. Those engines give us an object lesson in durability that even the very best high speed builders do not expect to reach. Bro. Heale tells us of the great advances made by the high speed builders in the general workmanship and proportion of their engines ; now I think we will all admit that the builders of slow speed engines have also adopted good proportions and better methods of construction, and his reference to the breakdowns or fly wheel accidents to the slow engines during the past year can hardly be taken as a very strong point against that style of engine, as it is only necessary to build the fly wheels stronger and put on automatic stops to act in case the governor fails in its duty. The mechanical engineers had hopes that a great saving in steam from cylinder condensation would follow a high rotative speed, but the result has been somewhat disappointing to them, or at least it has developed the fact that they lost more in the clearances they must necessarily use than they saved from cylinder condensation. I have made or copied 2 diagrams from 2 engines—one a 12″ × 12″ running at 300 revs., and one a 12″ × 30″ running at 100 revolutions per minute. In doing this I have tried to get a good card from each engine. We will now look at the difference in them, using the same steam pressure and cutting off the steam at the same point in each case.



Cylinder 12″ × 12″ Revs. 300



Cylinder 12″ × 30″ Revs. 100

In some of the high speed engines the clearance is as much as 20% of piston displacement, and very few below 12% ; in fact it is only recent engines that reach the lower figure. Slow speed clearances run from 3% to 8% ; we will take 5% as a fair average, or .05% of piston displacement. The high speed piston displacement in our card is 1357.20 cubic inches ; clearance equals 203.58, or 15% ; this filled 600 times in one minute equals 122,148 cubic inches. If this was all lost it would be ruination to the economy of the engine. Part of it is utilized in compression to fill up the clearance. In this case the compression pressure went up to sixty pounds, thus reducing the loss by two-thirds, which would represent at least 4 lbs. water per h. p. per hour. This great amount of compression also has the effect of reducing the M. E. P. of the card, and the power of the engine accordingly. The M. E. P. is 37.7 lbs., and the H. P. is 77.54, as measured from the card. The slow speed engine has a piston displacement of 4071.6 cubic inches ; the volume of the clearance is 5%, equals 203.58 cubic inches : this waste room is filled up 200 times per minute in this case, and amounts to 40.716 cubic inches. Now, in this card we only have about 16 lbs. pressure made by the compression, and our gain for that reason is very small. Our waste water amounts 2.021 lbs. per H. P. per hour ; this is without any allowance for compression, so we presume that we gain .021 of a pound by it. The M. E. P. of the slow speed card is 41.5 and the total H. P. is 85.36. This gain in power is somewhat used up in extra friction with shafting, pulleys, etc. In oil and general wear the slow speed has the advantage. The manufacturers of high speeds have done wonders in the way of improving the methods of construction, and all these methods have been utilized by good slow speed engine makers.

Bro. Ed. Phillip, of the incandescent electric light station, then took the floor and proved himself an able advocate of the high speed engine. He said : I think in taking up this subject for debate we should have defined the term "high speed engine" and should have attached some specific purpose to the subject of debate. High speed applies really to piston speed, and as all piston speeds are high to-day compared to the time of James Watt, we may say all engines are high speed. I understand it is really Corliss or equivalent valve gear against wheel governors. Now I do not believe that engines with wheel governors are adapted in point of economy for all purposes, alongside of the long stroke automatic, but there are places with variable loads where the short stroke or high speed engine will show a greater degree of economy than the slow speed, as has been proved in railroad work in the United States. Take an engine with a load that is one-fourth its maximum,—the engine with high rotative speed will show a degree of economy over the slow speed, but as the load approaches maximum, so will the economy of the slow speed overbalance the high speed, and when the average and maximum load is nearly the same, the slow speed is the more economical. It is well known that in the high speed, condensation is less than in the slow speed ; and as condensation is loss, this is one point in economy in favor of the high speed. The range of cut-off is much greater without loss of speed in the short stroke engine with wheel governor than in the long stroke or slow speed engine. Take the two kinds of engines and let each have one revolution, drop from no load to full load, and see the difference in the percentage of speed ; for instance, an engine running 100 revolutions per minute and another running 300—the loss in the first is one per cent., in the latter ⅓ of one per cent., which is a very important factor, especially in electric lighting. The shape of the card in the modern high speed is the same as the Corliss ; the only point that changes is the cut-off. A great many engineers object to the high speed engines on the score of hot boxes, broken cross-heads, bursting cylinders, &c., but these difficulties are only imaginary. I do not think a high speed engine requires any more watchfulness on the part of the engineer than the slow speed, and during the time that I have been operating them I have come to the conclusion that the high speed engine is better adapted to variable loads than the slow speed.

President Wilson Phillips said he supposed according to the rules of debate he as president should not be allowed to say anything either one way or another, but he could not allow some of the statements made by Bro. Ed. Philip, relative to slow speed engines, to go unchallenged. In the first place he contended it that is possible for the governor of a slow speed engine to work very accurately, even if the load thrown off and on amount to 70% of the total power of the engine. If when standing by an engine, when a load comes on and off a variation in speed is noticed, then there is something radically wrong with the governor. If a spring governor, there is too much tension or too little ; if a ball governor, then the weights are not adjusted right. He had stood by slow speed engines driving electrical apparatus where changes of load were frequent, but not the least variation of speed in engines could be detected nor could any difference be observed in the lights, because the governors of those engines were working correctly. He said further that the slow speed engine does not require the same lynx-eyed watchfulness on the part of the engineer that the high speed does, for once it is in good working order it will keep so for a long time whilst a high speed may start up seemingly all right and before it has got through its trip it is pounding like so many steam hammers. In the matter of oiling, the oil can be put on a slow speed engine's bearings where it is required : the engineer does not need to throw it at random as does the engineer of the high speed, who oils the frame and bed as much or more than he oils the wearing parts. Repairs to slow speed engines are infinitesimal compared with those of high speed. Slow speed engines do not often require cylinders to be bored out, nor boxes and bearings babbitted, piston rods turned up, &c., but it is a common occurrence for the high speed engine to undergo these repairs. Then as to the cleanliness of the two engine rooms, in the one everything is polished and bright, whilst in the other the floors reek with oil, the bed and frame of the engine ditto, and the passer-by is bespattered with oil from head to foot; the engines revolving so swiftly seem to draw all the dust from the four quarters of the earth, and it seems to settle on everything in the place. Then when there are many high speed engines at work the sum of all their great clearances must make the fuel bill very expensive, whilst in the slow speed all those wasteful clearances are compressed into the one engine, and percentage of clearance in the slow speed being so much less than in the high speed it must result in a great saving of fuel. Again, the roaring of exhausting steam of high speeds is very annoying, whilst with slow speeds the steam is exhausted down to atmospheric pressure, thus making but very little noise. Taking his own experience into consideration he preferred the slow speed to the high speed.

This ended the debate.

At the regular meeting on February 9th, there was a good attendence notwithstanding the very stormy night. Various reports from committees were received, commented upon and adopted. The president gave out the new pass-word and those members who were not present should get it without delay, as without it their admittance to future meetings will be difficult if not impossible.

The business part of the meeting was pushed through as rapidly as possible until "Good of the Order" was called. Under this heading the decision of the judges in the late debate on the subject of "High versus Slow Speed Engines" was loudly called for. By an agreement among the judges, Bro. Gilchrist had been appointed to render the verdict. In doing so he expressed his regret that the Association had appointed him as judge, thereby completely closing his mouth. During the hottest part of the debate he was obliged to hold himself down in his seat to keep from expressing his views. With great difficulty he managed to keep out of the discussion, but in future some other person would have to be judge, for he proposed having a hand in the next debate. He hoped the two contending parties would bury the hatchet and immediately go in training for another fight, for he believed such debates were the making of young engineers. By a series of calculations which he explained he declared that the advocates of "slow speed" had beaten the "high speed" men by six points to four. This decision of the judges is not to be regarded as any reflection on high-speed engines, but that the slow speed advocates presented their case in a better light than the high speed men. The "high speed" men, after putting their heads together for a few moments, were overheard predicting renewal of the battle and an overwhelming defeat for their opponents in the near future.

Bro. Edkins, who had arrived home a few days before the meeting from a visit to his home in England was asked as to his welfare, and for a few words about his trip. In a short speech he expressed his thanks for the interest manifested in his welfare and assured the brethren that he had enjoyed himself thoroughly, with the exception of the return trip, on which his vessel had encountered foul weather and accidents by reason of which she was delayed for six days. He then described the series of accidents that befel his ship and the means the engineers aboard took to repair the damages.

The "Question Box," which is always present, was on this occasion overflowing, and the president had serious intention of calling a special meeting to dispose of the numerous questions. However, some were answered, and some taken home by members to be explained at next meeting on February 23rd.

CHAS. F. KINSEY,
Corresponding Secretary.

ANNUAL DINNER MONTREAL NO. 1.

The annual dinner of this Association was held on the evening of February 2nd, at the Richelieu Hotel, and was a most enjoyable affair.

The chair was occupied with much felicity by the President, Mr. J. G. Robertson, who first proposed the toast of "Queen and Country" which was duly honored.

This was followed by the toast of "Electrical Engineering," which was responded to by Messrs. J. Smillie and J. J. York.

Mr. Smillie, after explaining that he had been called upon most unexpectedly and felt unprepared to respond to the toast of one of the most important sciences that the practical mind had to grapple with to-day, said every one at present was almost compelled to take an interest in electricity for the practical applications of it were to be met everywhere. It used to be said that an electrical engineer should be nine parts mechanical and one part electrical. Now, however, electricity and mechanics were more nearly equal and he considered that the proportions should be about three parts mechanical and two electrical. Electricity and mechanics had both made great progress, but recent accidents had shown that there was something still to be accomplished in the practical application of these sciences.

Bro. J. J. York, in replying, said it was strange no explanation had been given of the cause of the accident which had recently happened to engines in electric power and lighting stations.

If he had time he would like to make some experiment to ascertain if possible why these engines had run at a considerably higher speed just before the accidents, which apparently was the cause of the break down. He might then be able to throw some light on the question. Notwithstanding the fact that the strength of the fly wheels had been increased in modern times, they still occasionally gave way.

The next toast was that of the "Manufacturing Interest" and was responded to by Messrs. Hugh Vallance, Andrew Young and H. Mitchell.

Mr. Vallance, in replying, said the manufacturing interests were in a flourishing condition in Canada, though somewhat unsettled by rumors of changes in the tariff. He advocated the placing of a higher duty on scrap iron, which would cause the rolling mills to use iron from native ores and lead to the establishment of smelting works throughout the country.

The toast of "Steam Engineering" was then proposed, and was responded to by Mr. P. Cowper, who said that though the methods employed in steam engineering had been improved since the time of James Watt the principles had practically remained the same. In his time, all engines were of the vertical type and to-day this type is returning to favor. He then gave a brief history of the steam engine from the first crude types to the present highly developed forms.

"The Faculty of Applied Science" was next toasted enthusiastically, but as Professor Nicholson of McGill University, who was to have replied, was unavoidably absent, there was no response.

The toast of "License Law and Inspection" followed, and was responded to by Mr. P. Fisher, who said that if governments were for the greatest good of the greatest number, the people should see that men were elected to Parliament who were pledged to introduce a license law. No one had a right to kill his neighbor with impunity. If he wished to kill his enemy and did it with a revolver, he would be punished by the government, but if he invited his enemy to visit his boiler room and increased the pressure so as to cause the boiler to explode and thus blow his enemy into eternity, the verdict would be "accidental death."

The next toast was to the "Brotherhood of Locomotive Engineers," which was coupled with the name of Mr. Thomas Clark, who said the present idea was to resort to legislation instead of strikes. Legislation could be easily obtained if all were united. He then gave a brief history of the Lehigh Valley Railroad strike which he said had been caused by the failure of the officers of the company to keep their agreement with the men.

The National Association of Stationary Engineers and the Canadian Association of Stationary Engineers were then toasted.

Bro. Hunt, in responding, said among other things, that the motto of the Canadian Stationary Engineers was "Forward." The Association endeavored to educate its members up to a high standard, and he hoped the engineers would never be obliged to resort to strikes in self defence.

Bro. York also responded, and in the course of his remarks said employers should understand that the object of the Association was to educate its members. The meetings were solely for the purpose of mutual improvement.

Mr. Cowper advised the younger members as well as the older ones if they were going to leave their employers to keep the machinery in the best possible order up to the last.

Then came the toast of the "Press" which was responded to very happily by the representative of the Canadian Engineer. During the evening songs were given by Messrs. Hunt, Cowper, and Wheeler.

We are indebted to Mr. C. E. Robertson, of Winnipeg, for some particulars of a meeting of engineers held in that city recently with the object of forming an Engineers' Association. The meeting was held in Mr. Robertson's office in the Grain Exchange. Among those present were the following:—Mr. C. E. Robertson, Edward Alberg, James T. McDonald, J. A. Binns, H. A. Stratton, L. Brandon, John Stanley, J. Schneider, T. Haynes, J. Harrison, T. Gordon, W. Brown, M. Saunders, Robert Hall, of Winnipeg, and C. R. Forge, of Morden. Mr. Robertson was elected chairman, and after having discussed the advantages which would be derived by engineers organizing themselves into a branch of the Canadian Association of Stationary Engineers, it was decided that a register and the necessary papers be prepared and signed, and an application made for a charter.

MONTREAL ELECTRIC CLUB.

MONTREAL, February 18th, 1894.

Editor CANADIAN ELECTRICAL NEWS.

DEAR SIR,—I have been requested by the Committee of the Montreal Electric Club to express to you through this medium the hearty thanks of the Club for the interest and encouraging remarks you have accorded them, and also for space for papers in your esteemed journal, which last I might say raises the tone of the articles, and stimulates the writers to further efforts.

Yours respectfully,
JAMES BURNETT, Secretary M.E.C.
19 Shuter street, Montreal.

Mr. G. W. Stevens, one of the largest property holders of Montreal, threatens to bring suit for $80,000 damages against the City, on the ground of depreciation of the value of his property, should the construction of an elevated railway on certain streets be permitted.

ELECTRIC RAILWAY DEPARTMENT.

THE MONTREAL STREET RAILWAY SYSTEM.

The Montreal Street Railway have lately experienced hard luck. In the temporary power house on Cote street they have two high speed engines, one belted to two Westinghouse generators, the other to two Edison. One night recently they had some trouble with the engine running the Westinghouse generator. This was promptly repaired, however, only to be followed the succeeding day by the one which was running the Edison generators going all to pieces. One piece went through the roof and fell in the yard. It is difficult to say what really was the trouble. The engine was one of the Harrisburg "Ideal." The brunt of the work was then thrown on to the remaining engine on Cote street and the one at the Royal Electric Company's works. At 6 o'clock on the same day the armature of one of the generators at the Royal Electric Works burnt out. The Street Railway Co., however, hustled things at their new power house on William street and are running part of it now.

Between the thankless public (who forget the old times, when their feet were soaking in wet pea straw and their heads thrust against a frosted canvass roof) and very inclement weather, they are indeed to be congratulated that they have managed to keep cars out on the road at all.

LEGAL DECISIONS.

The following cases were recently argued at Toronto before Chief Justice Galt, Justices Rose and McMahon :—

EWING V. TORONTO RAILWAY CO.—Judgment on motion by the defendants to set aside the verdict and judgment entered by Street, J., who tried the action at Toronto with a jury, awarding the plaintiff damages to the amount of $1,400 for injuries received by him in a collision with an electric car on the defendant's street railway line at Tannery Hollow in Yonge street in the City of Toronto. The plaintiff was going south in Yonge street on the street railway track in a democrat waggon driven by one McMillan, and was overtaken by the car, which was moving at a high rate of speed. The defendants contended on this motion that speed, however great, did not per se constitute negligence; that the very object of the legislation incorporating the company was to insure rapid transit; that the burden of care to avoid a collision lay on the person whose business it was to get out of the way, and not on the motorman, who had the right of way; that there was room on each side of the track; and that the accident was attributable to the negligence of McMillan in remaining on the track and attempting to keep ahead of the car (whose approach he had observed at a distance of 75 yards) until it was too late for him to turn off in safety. Motion dismissed with costs, the court holding that the case could not properly have been withdrawn from the jury, and as the evidence was of the most conflicting character the jury's findings could not be set aside or ignored. McMahon, J., referred to the fact that in Osgoodby v. Toronto Street Railway Co., a high rate of speed was held not to be per se evidence of negligence. Rose, J., was of the opinion that a rate of speed might be too great under certain circumstances, and not so under others, and that it was always a question for the jury.

GOSNELL V. TORONTO RAILWAY COMPANY.—Judgment on motion by the defendants to set aside the verdict and judgment entered by Street, J., who tried the action at Toronto with a jury, awarding the plaintiff damages to the amount of $1,160 for injuries received by him resulting from a collision between a waggon driven by him and a car on the defendants' street railway line at the intersection of Scollard and Yonge streets in the City of Toronto. The defendants contended that the evidence showed that the driver of the car had exercised due care and had done all in his power to stop the car, and that the plaintiff had been guilty of negligence. Motion dismissed with costs, the Court holding that the finding of the jury could not be interfered with upon the evidence.

GRINSTEAD V. TORONTO RAILWAY COMPANY.—Judgment on motion by the defendants to set aside the verdict and judgment for the plaintiff entered by Street, J., who tried the action with a jury, awarding him damages to the amount of $500 for his ejection from a car on the street railway line operated by the defendants. The plaintiff claimed to be entitled to ride on the car as a transfer under an agreement between certain persons (who subsequently assigned their rights thereunder to the company) and the corporation of the City of Toronto. The conductor refused to accept his statement that he had been properly transferred from another car, on which he had paid his fare, and the plaintiff's health suffered in consequence of his being obliged to wait in the street in very cold weather for another conveyance. On this motion the defendants contended that the evidence did not show that they were strictly speaking, subject to this clause of the agreement under which alone the plaintiff's action could be brought; that it was incumbent on the plaintiff, at all events, to show that transfer provisions were in force and that he had complied with them, and that the learned trial Judge had erred in allowing evidence to be given and damages to be assessed in respect of the injury to the plaintiff's health, such damages being too remote. The jury found $200 for the assault and $300 for the plaintiff's consequent sufferings. The jury found that the injury was the natural and probable result of the ejection. Under these circumstances the Court held that the case had been properly submitted to the jury, that there was evidence to go to the jury, that the defendants were operating the railway, and that the verdict could not be disturbed. Motion dismissed with costs.

THE PRESERVATION OF BELTS.—The following empirical formula fo a machine belt preservative is due to L'Industrie: Warm in a covered vessel to a temperature of 50° C., 1 kilogramme of india-rubber broken up into pieces and mixed with 1 kilogramme of essence of turpentine. After the rubber has melted add 800 grammes of colophone; stir until this too is dissolved, then add 800 grammes of yellow wax In another vessel put 3 kilogrammes of cod liver oil, and 1 kilogramme of tallow; heat this mixture until the tallow melts, and then pour it into the first vessel, stirring continually until the mass cools and solidifies. Belts, the working faces of which are occasionally treated with this compound, are said "to acquire greater solidity, and slipping at the pulleys is avoided."

SPARKS.

The Toronto Railway Company's cars have recently been fitted with passenger registering devices.

It is said to be the intention to extend the Walkerville Electric Railway to a point opposite Belle Isle, and to establish a ferry line to connect Belle Isle with the Canadian shore.

The necessary legislation has been obtained authorizing the Montmorency, Quebec and Charlevoix Railway Company to change their motive power to electricity and to run their line into the City of Quebec.

Mr. James Armstrong, on behalf of himself and other ratepayers of the Township of York, is endeavoring to quash a by-law passed by the township granting a bonus of $20,000 to the Toronto and Richmond Hill Railway.

A Sydney, N. B., law firm, at the head of which is Mr. Gillies, M. P. for Richmond, is asking for the incorporation of the Boynton Bicycle Electric Railway Company of Canada, to run from Winnipeg, Man., to Louisburg, N. S.

The construction of 50 new motor cars and 50 trailers has been commenced in the Toronto Railway Company's shops. From these shops 180 cars have been turned out. These cars are in use in Montreal, Winnipeg and elsewhere.

The Peterboro' Electric Railway Company has been much annoyed by stones being placed on the track by boys, and by drivers of vehicles getting in the way. The Railway Act, under which electric roads are operated, provides severe penalties for those who thus obstruct the cars.

Two of the new engines in the Montreal Street Railway Company's power house, were put in successful operation a few days ago, developing 1,000 h. p. There will ultimately be six engines. It is expected that 65 miles of road will be in operation at the commencement of the summer.

An inspection of the new bridges to be used in the double tracking of the Niagara Falls, Park and River Railway, was recently made by Mr. W. T. Jennings, the engineer, and Mr. W. A. Grant, general manager of the road. The second track is expected to be ready for traffic in the spring.

Mr. Campbell, manager of the Winnipeg Electric Street Railway, has returned to that city after spending a considerable time in Ontario. Immediately following his return, he announced a reduction in the price of tickets. 50 tickets are now being sold for $1.00. This reduction, it is understood, has been brought about by competition with other roads.

The following gentlemen have been elected directors of the Quebec Street Railway Company for the ensuing year: C. St. Michel, G. R. Renfrew, W. Hossack, J. C. Thomson, D, C. Thomson, G. Lemoine and F. Tessier. Messrs. C. St. Michel and W. Hossack were respectively elected President and Vice-President at a subsequent meeting of the new board.

The Hamilton Beach and Electric Railway Company is seeking incorporation. The capital stock of the company will be $48,000, divided into 480 shares of $100 each. The following are the incorporators: Messrs. John Calder, J. N. Waddell, A. E. Carpenter, Robert Campbell, of Hamilton; W. Kearns, M.L.A., Richard Baxter, and W. Allen, Burlington.

The Toronto Railway Company will apply to the Ontario Legislature for an amendment to their act of incorporation empowering the Board of Directors to increase the number of directors and make regulations in relation to the transfer of the stock of the company; also to authorize the company to establish superannuation, provident and insurance funds for its officers and employees.

Application is being made by officers of the London Street Railway Company for the incorporation of the London and Springbank Electric Street Railway Company, to construct and operate an electric railway from the boundary of London to a point on the river Thames near Springbank. Power is also sought to acquire or build a hotel and recreation grounds at Springbank.

Negotiations are in progress between the town council of Cornwall, Ont., and Mr. W.R. Hitchcock, who is seeking a franchise to operate an electric street railway to carry both passengers and freight. It is proposed to form a company for this purpose, and utilize power from the Cornwall Canal, which will be made available on the completion of the dams now in course of erection at Sheik's Island.

The Hamilton Radial Electric Street Railway Company is seeking to have its charter amended in such a way that the word "street" shall be struck out of the name of the Company and the capital stock increased from $1,000,000 to $2,000,000. The purpose is to extend the line from Hamilton to Niagara Falls and Brantford, from Oakville to Mimico, and from Elmira to other places in Waterloo County, also to convey power from Niagara Falls to Hamilton for manufacturing purposes. The Company claim to to have already secured contracts for the supply of 5,000 h.p. to Hamilton manufacturers.

The City Council of Toronto is seeking legislation from the Ontario Government to compel the Toronto Street Railway Company to place vestibules upon their cars. The Council will also ask power from the Legislature to enforce the terms of the franchise granted by the County of York to the Toronto and Mimico Electric Railway. This road is now within the City limits, and a dispute has arisen between the City Engineer and the company regarding the maintenance of the roadway between and at the sides of the track. There is also involved the question of the right of the City Council to representation on the Board of Directors of the Company.

The County Council of York, at its last meeting, approved of an agreement with the Metropolitan Railway Company giving to the company power to extend their line northerly on Yonge street, by electricity, cable or horse power, provided the northern limit of Richmond Hill is reached by said extension; also extending the company's franchises for 35 years from this date, renewable on such terms as may be determined by arbitration. Under the agreement, the company must build the road before the first of October, 1895, unless by the certificate of the County Engineer and Solicitor it shall appear that they were unavoidably prevented from so doing, in which case the time may be extended until the next ensuing meeting of the Council. After the line shall have been completed to Richmond Hill, the company must within two years proceed with the further extension of the line northward; in default of so doing the agreement may be revoked.

A company is being organized at Lethbridge, Alberta, to construct a telephone line between that place and Cardstone.

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Write to nearest office for prices and discounts.

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PERSONAL.

Mr. Henry W. Darling, late of Toronto, has been elected assistant treasurer of the General Electric Company in the United States.

Mr. Matthew Kennedy, of the firm of Wm. Kennedy & Sons, has been elected President of the Owen Sound Board of Trade, and Mr. S. J. Parker, of the Electric Light and Power Co., to a seat on the Council of the Board.

On severing his connection with the Royal Electric Company, to assume the management of the Montmorency Light and Power Company, Quebec, Mr. F. H. Badger, Jr., was presented by his fellow employees with a gold chain and locket.

The position of Electrical Superintendent of the Hamilton, Grimsby and Beamsville Electric Railway, has been offered to Mr. F. E. Handy, who lately returned to Toronto from Vancouver, B. C. Mr. Handy has accepted the position, and will enter on his duties on the first of April. The appointment is one which is likely to be mutually satisfactory to the parties concerned.

We regret to have to record the death of Mr. Mohr, manager of the Quebec and Levis Electric Light Company. Mr. Mohr's death was due to inflammation of the lungs, induced by a severe cold which he contracted while superintending repairs during a heavy snow-storm. The deceased, who was 67 years of age, was the original promoter of the telephone and electric light in the City of Quebec, and more recently of the proposed electric street railway.

For nearly half a century Geo. H. Simon lived the life of a recluse at Mimico, on the boundary of the City of Toronto. Very little was known about him, even by his immediate neighbors, beyond the fact that he was deeply interested in scientific studies and experiments. Latterly the fact leaked out that he was engaged on the problem of producing electricity without the aid of a steam engine, and he claimed that the discovery would shortly be put in practical form and patented. A couple of weeks ago the house in which the old man lived alone was discovered to be on fire, and the occupant in his frantic endeavors to save the building, and the models, etc., upon which he had for so many years been working, sustained such injuries from fire and frost as shortly afterwards proved fatal. The deceased was nearly 87 years of age. Whatever value might have attached to his labors had his life not been so suddenly cut off, it is impossible to say, as everything was swept away by the fire.

AN EXCELLENT IDEA.

The Columet electric street railway, operating about fifty-four miles of track in the southern part of Chicago and a number of its suburbs, has placed in each of its cars a map about 17 x 14 inches in size which shows plainly how to get to points on the line. The map is a blue print, the routes are shown in heavy white lines, and only the streets through which the tracks run are given. The names of these streets and of the suburbs are printed in large white letters, easily read from any seat in the car. The maps have proved of much value to the visitors in Chicago during the Columbian Exposition as well as to the residents of the sections where the lines run.

TBADE NOTES.

It is said to be the intention of the General Electric Co., to engage in the manufacture of electric cars.

The Toronto Railway Company have given a contract to the Canadian General Electric Company for 80 street car motors.

It is reported to be the intention of Messrs. T. W. Ness & Co., of Montreal, to establish a branch of their business in the United States.

Mr. Waderlow, of Leamington, Ont., has made arrangements with an Illinois firm to commence the manufacture in Canada of steam governors.

The Electric Light Co., Windsor, N. S., are increasing their plant and have ordered a 150 horse power Tandem Compound Robb-Armstrong engine.

The Montreal Electric Company are manufacturing a transformer for doctors' and dentists' use for reducing a 52 volt incandescent current to a current of from 2 to 6 volts.

The Canadian General Electric Company have recently issued and sent out to their customers and friends, a very neat and useful souvenir in the shape of a memorandum book.

The fame of the "Packard" lamp has extended to Brazil, from which country an order for 10,000 lamps was received recently at the Packard Lamp Company's factory in Montreal.

Messrs. Ahearn & Soper are putting a new trolley bell or line insulator on the market. It is made of malleable iron and is said to be a great improvement over anything heretofore used for this purpose.

It is a good plan to watch your voltage pretty close on incandescent lighting mains, as a few volts variation above the normal is apt to play havoc with the lamps, and reduce their life very materially. Most standard machines will regulate very closely and need little watching, but as an engineer watches his water line, regardless of the fact that he has a tell tale on it too, so the dynamo tender should watch the voltage, or the potential indicator occasionally in spite of the fact that he has a regulator on the machine, either in the form of compound windings or otherwise. Plants that have no measuring instruments are not included here, as then the only guide is the lamp's brightness as judged by the eye, which is by no means a sure indication. Potential and current indicators are cheap now and should be used on every circuit, no matter if the dynamo is only lighting your own shop.—American Mechanic.

The new power station of the Montmorency Light and Power Company, Quebec, has been completed, and a contract given to the Royal Electric Company for a large alternating plant to replace the old one. The machinery will be operated by eight horizontal water wheels working under a head of 160 feet and run at 600 revolutions per minute. Four of these wheels are of a capacity of 620 h. p. each, and four of 310 h. p. each. The smaller wheels will be used to operate the arc plant and the larger wheels, the alternating dynamos, comprising four 210 k. w. machines, which will be run at 600 revolutions per minute, the current having a frequency of 60 periods per second and a pressure at full load of 2,500 volts. Two dynamos will be mounted upon a single base, connected by clutch coupling, and arranged so as to be capable of running in parallel and giving two phase currents for power; each pair will be belted to a 620 h. p. water wheel. The switch-board will be of marble, and so divided fnto sections as to allow of additional machines being connected.

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SPARKS.

There is a movement on foot to establish an incandescent lighting plant at Napanee, Ont.

The Toronto Railway Co. have placed an order with Messrs. Ahearn & Soper, of Ottawa, for 40 additional Westinghouse equipments.

A dispatch from London, Eng., announces that Mr. Geo. A. Goodwin, a Canadian, has been elected president of the Society of Engineers.

Mr. C. J. Myles, president of the Hamilton, Grimsby and Beamsville Electric Railway, was in Ottawa a few days ago with the object of endeavoring to induce the Customs Department to allow the steel rails for the new road to be brought in free of duty.

Messrs. R. Wilson Smith, John Torrance and Albert W. Atwater, of Montreal, Henry W. Darling, of Toronto and Boston, and Robert H. Fraser, of Toronto, are asking to be incorporated as the Toronto Suburban Railway Company, with power to take over the franchises and property of the City and Suburban Railway Company and the Davenport Street Railway Company.

At the annual meeting of shareholders of the Hamilton Electric Light and Power Company, held on the 9th of February, Mr. Robert Thomson was elected president, and Mr. John Knox, vice-president of the Company. The following directors were elected for the ensuing year: Robert Thomson, John Knox, J. M. Lottridge, Alexander Turner, Robert Evans and J. V. Teetzel, Q. C., of Hamilton, and Messrs. S. F. MacKinnon, A. H. Campbell and H. M. Pellatt, of Toronto.

The engineer of the steamer Ariel, owned by Messrs. Hiram Walker & Sons, of Walkerville, Ont., and which runs between Walkerville and Detroit, discovered a few days ago, when about to start up the engine, that some miscreant had unscrewed and removed a number of nuts and bolts, leaving the machinery in such a condition that serious damage would have resulted from putting it into operation had not the matter been fortunately found out. Detectives are at work on the case.

The Fire and Light Committee of the City Council of Woodstock, Ont., have been instructed to ascertain fron the Electric Light Company of that place on what terms they would be willing to enter upon a renewal contract for one, two or three years from November next; also at what price they would be willing to sell their plant to the city; and if the information on these points is not considered satisfactory, to advertise for tenders for lighting and plant, and report to the Council in April.

The St. Jean Baptiste Electric Light Co., of Montreal, were reported to be in difficulties lately. They are said to have called a meeting of several of the important creditors, among whom might be mentioned Messrs. Ahearn & Soper, of Ottawa, and it is understood that the difficulties have been tided over and matters arranged. We hear that the arrangement for creditors over $200.00 was that they would receive notes for their claims at the rate of 50 cents on the dollar; the smaller creditors would probably be paid in full.

Some very striking and original effects in electrical illumination were introduced at the Academy of Music, Montreal, during the recent production of "Erminie" by the Montreal Amateur Operatic Club. Over 450 five c. p. Packard incandescent lamps were used to light up the stage and scenery. Bouquets and stands of flowers were made brilliant by miniature incandescent lamps among the flowers. On evenings when some of the local clubs attended in a body, the letters composing their initials were spelled out in lamps of the club color. These illuminations were a very attractive feature of the entertainments and reflected much credit upon Mr. C. W. Henderson, electrical contractor of Montreal, who designed and carried out the illuminations.

The Street Railway Review for February publishes illustrations and a description of the suspended railway spanning the Tennessee River at Knoxville, Tenn. Two cables 1⅜ inch diameter are stretched across the river a distance of 1,060 feet. The ends of the cables at one side of the river are 350 feet above the starting point at the other side, or in other words the grade is about 33 per cent. The cable furnishing the motive power is one half inch in diameter and its permanently fastened to the car. The supporting cables each have a breaking strain of 60 tons. These cables are 350 feet above the river. The power is furnished by 20 h. p. engines. The cars are 14 feet in length, exclusive of a three foot platform, and are 6 feet wide and 6½ feet high, with a seating capacity of 16 passengers. The up trip takes about three and a half minutes, and the decent about a half a minute by gravity. The road is said to be well patronized.

The annual meeting of the Bell Telephone Co., took place at Montreal on the 22nd of February, the President, Mr. C. F. Sise, presiding. The annual report showed the gross revenue for the past year, to be $961,174.69, expenses, $724,791.42, making a net revenue of $236,383.37. The paid up capital is $2,421,600. The number of subscribers added during the year were 2,634 and the total number of sets of instruments now earning rental is 26,806. Twenty-four exchanges and fifteen agencies have been constructed and added to the system. The company now owns and operates 275 exchanges and 256 agencies. Two hundred and thirty-two miles of poles and 1,616 miles of wire were added to the long distance system in 1893. Of these 60 pole miles and 1,288 wire miles are in the Ontario department, and 172 pole miles and 328 wire miles are in the Eastern department. The long distance lines now owned and operated by the company comprise 12,071 miles of wire on 5,068 miles of poles. The assets of the company amount to $4,227,119.86, and liabilites $3,375,147.69, leaving a surplus of $851,972.17. There was no discussion on the report, and the shareholders showed their entire satisfaction by re-electing the old directorate.

Mr. Howard D. Black has resigned his position with the Royal Electric Co. of Montreal, and accepted that of electrician of the Chateau Frontenac Hotel at Quebec.

Mr. H. W. Woodman has severed his connection with the Montreal Street Railway Co., and accepted the position of electrician to the corporation of the town of Joliette, Que.

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SPARKS.

Application is being made to the British Columbia Legislature for a charter for a new telegraph company which proposes to construct a line connecting South Westminster with Vancouver, Victoria and Nanaimo, and making connection with the Great Northern system.

In London, Eng., there was recently discovered the apparatus by means of which Franklin produced an electric light sufficient for reading purposes. The current was generated from a large cylinder of glass, which was rubbed by brushes with silk covers, and a light made its appearance between a ball and a metallic point.

It is reported that the Ottawa and Chaudiere Electric Light Companies have purchased for $45,000 four water lots on the Chaudiere, which formerly belonged to Messrs. Perley & Pattee. For some time the water power belonging to these lots has been employed to run the dynamos of the Ottawa company. By this purchase the electric companies have secured control of four-twenty-sixths of the total power under lease from the Chaudiere.

The boiler in the steam saw mill owned by Joseph Warren, at Byers' Corners, near Ottawa, Ont., exploded a few days ago as the engineer was about to start up the machinery. The engineer, John Possett, a Swede, was blown a distance of thirty feet and had his skull fractured by a fragment of the boiler. Pieces of the boiler, tools, etc., were found hundreds of yards away from the scene of the explosion. Singularly enough, with the exception of the engineer, no one was injured.

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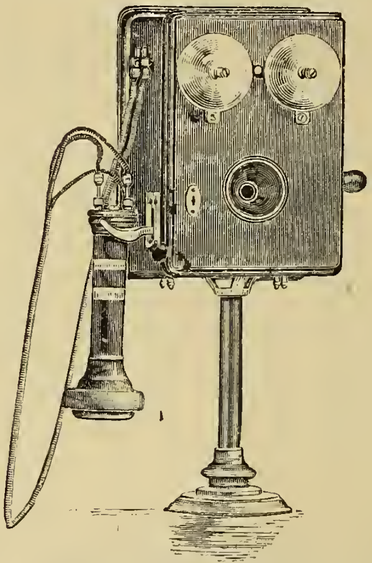

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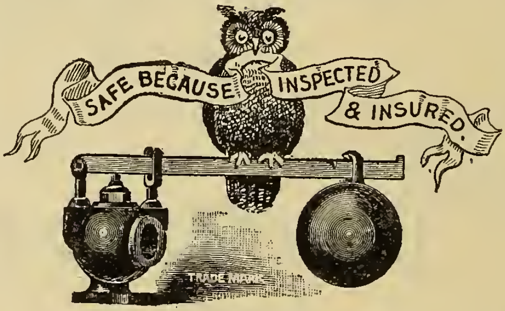

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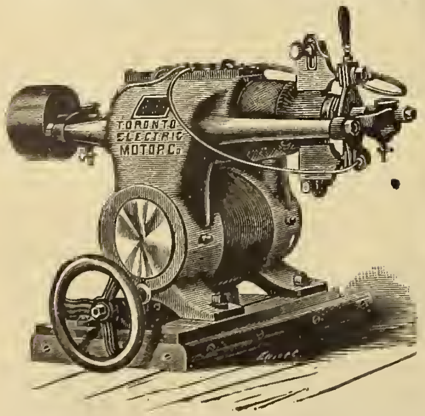
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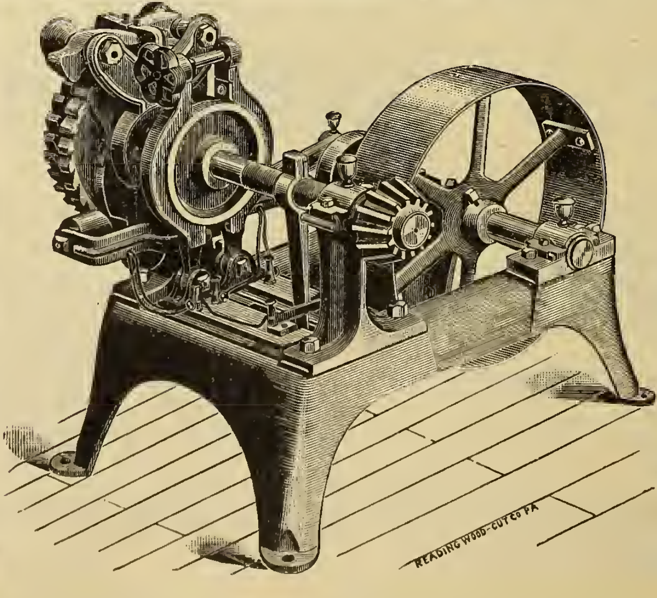

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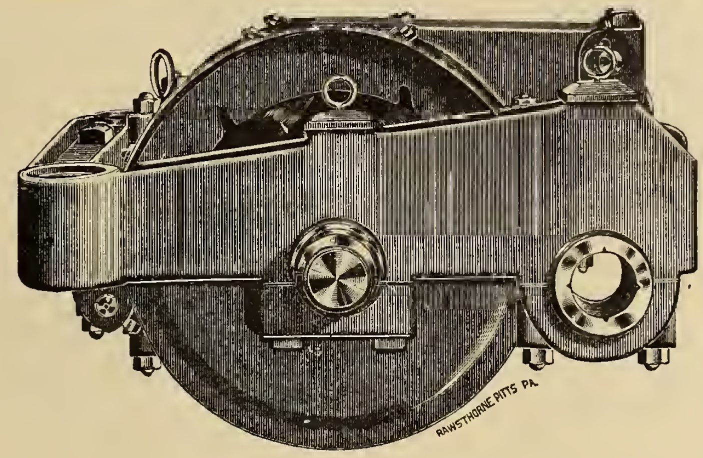
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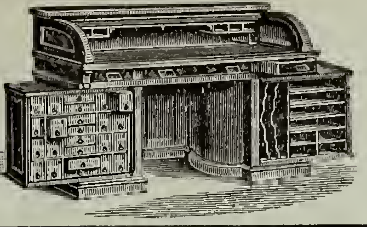

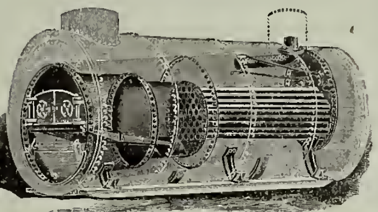

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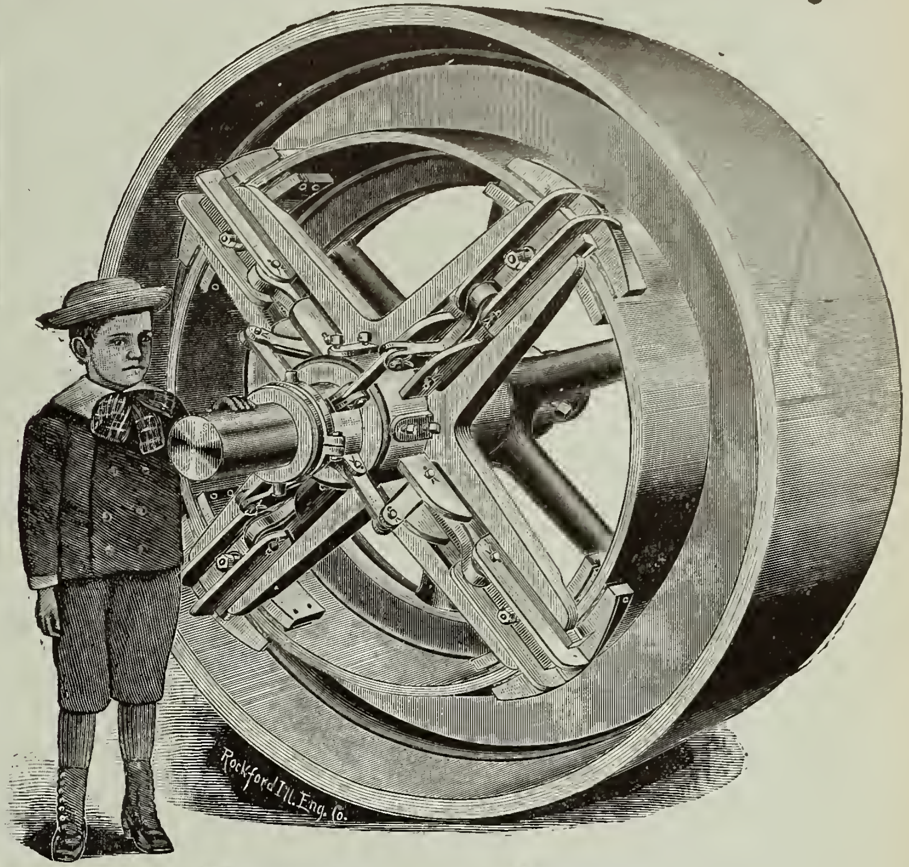
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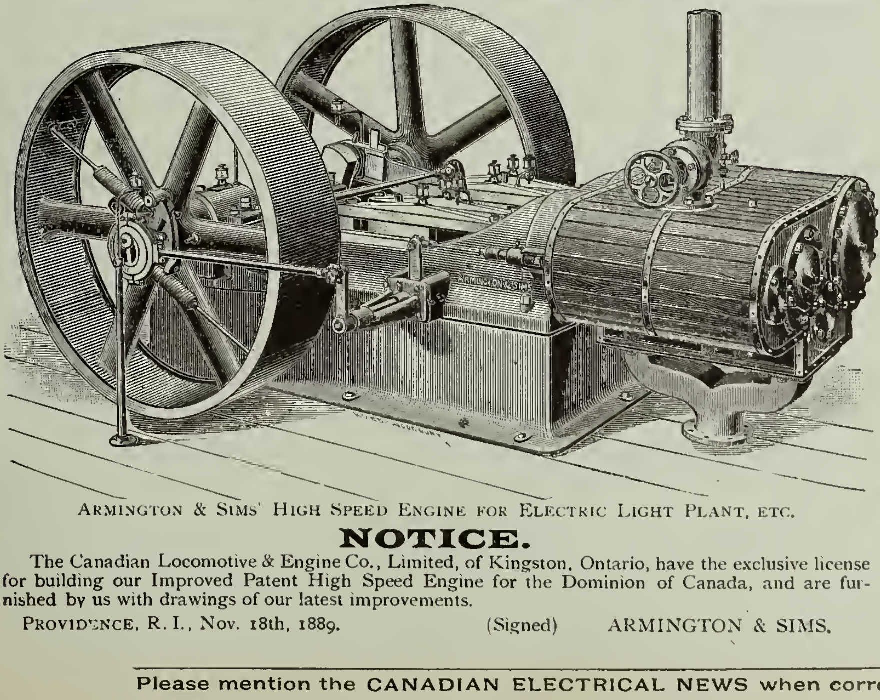

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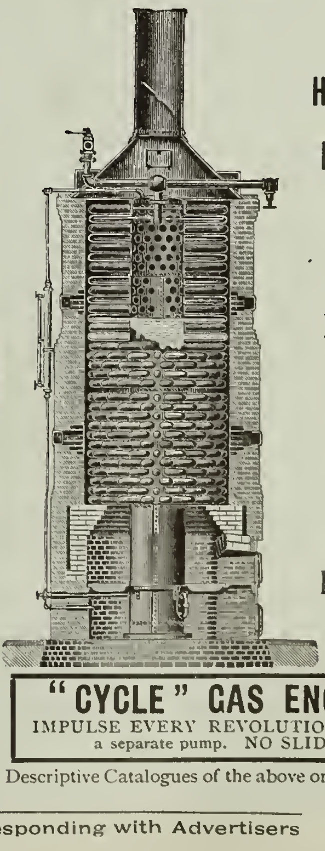

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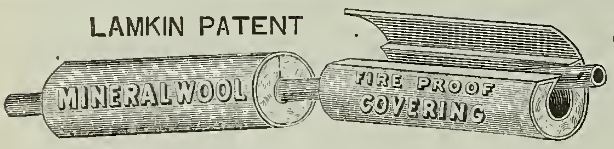

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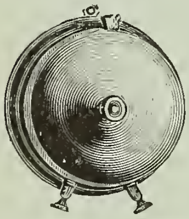

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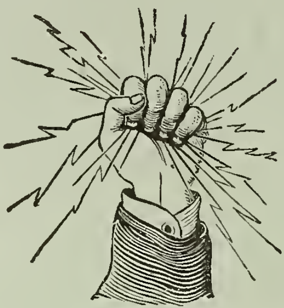

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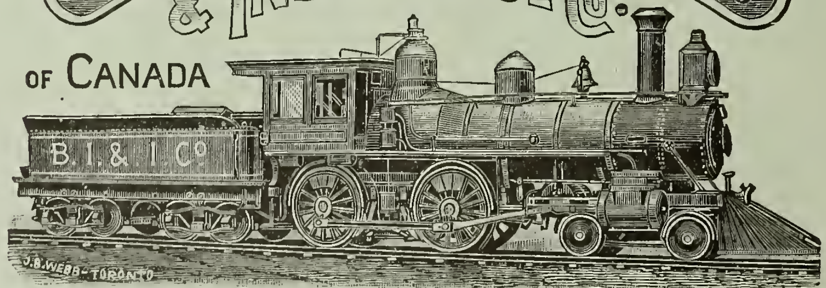

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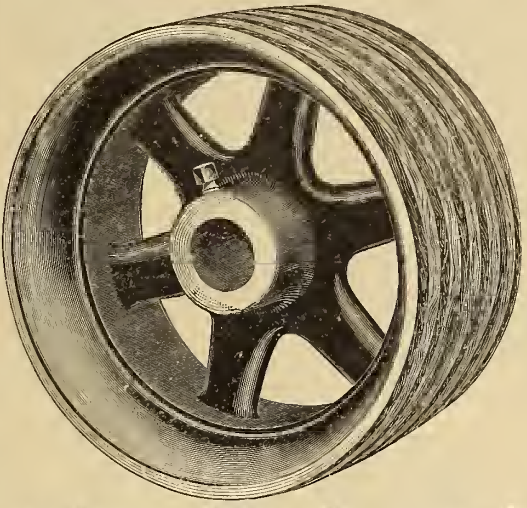

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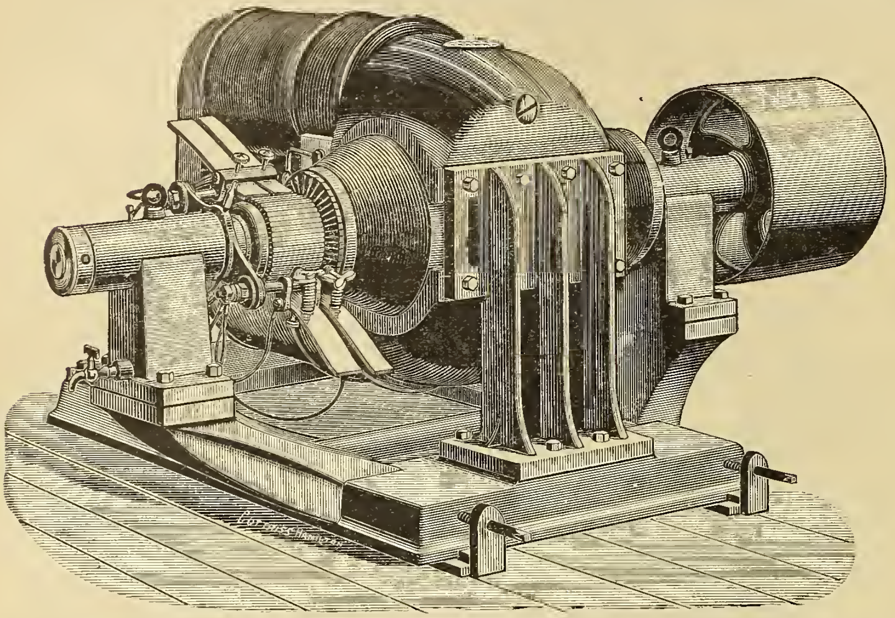

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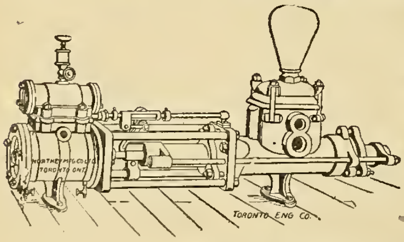
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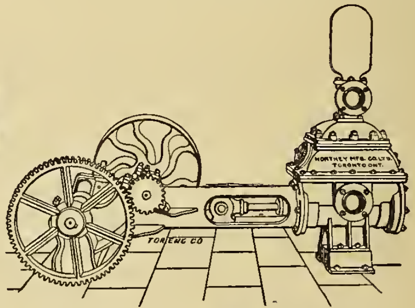
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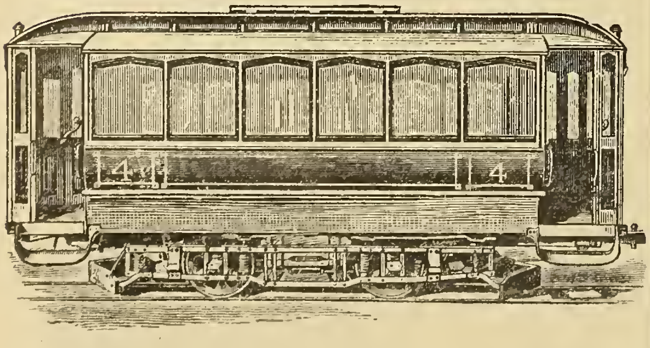

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CANADIAN
ELECTRICAL NEWS
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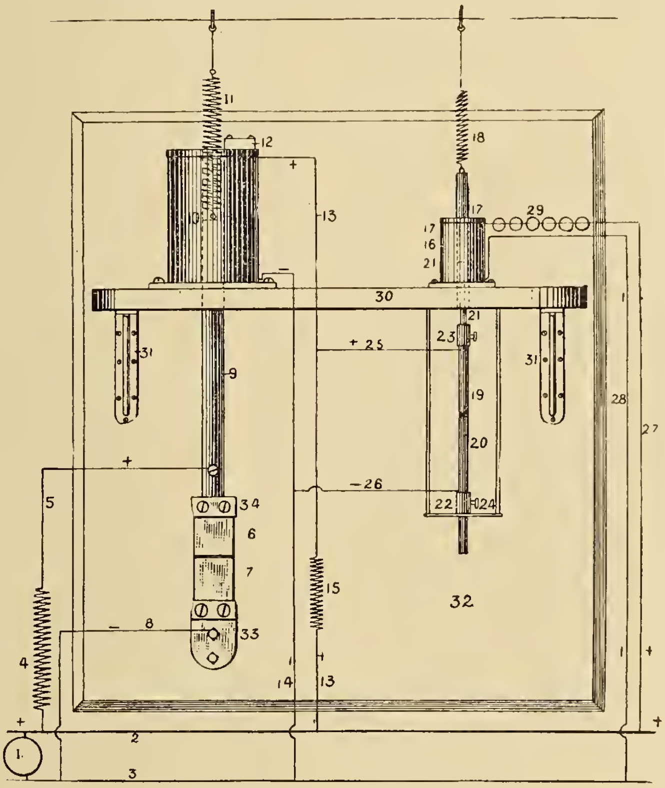
VOL. IV. APRIL, 1894 NO. 4.

SPEED AND VOLTAGE REGULATOR.

WE illustrate herewith a speed and voltage regulating device which has been in satisfactory operation for a year past in the water power station of the Niagara Falls Park and River Railroad Co. at Niagara Falls, and a patent for which has lately been granted at Ottawa. It is the invention of E. A. Barber, electrician of the Watertown, N. Y., Street Railway. In this method the speed is kept constant by automatically throwing in a dead resistance, when the load is small, and throwing this resistence out when the load is large. In the engraving, 1 is the generator, 2 and 3 the mains. The regulating resistance, 4, is thrown in and out by the contacts, 6 and 7. A solenoid, 16, is connected across between the mains, and hence its pull will vary with the voltage. When the voltage rises above a certain point, the iron core, 17 (which is normally held by the spring, 18), is drawn down, so that the contract is made between 19 and 20. These contacts is the coil 10, which is in parallel with the mains through a high resistance, 15. The coil, 10, being short circuited, the iron plunger, 9, is let down, the contacts 6 and 7 come together, and the load of dead resistance is thrown in. A piece of iron, 12, is put on top of 10 to assist in lifting the iron core, 9, and also to act as a stop when it is lifted. It is manifest that a number of these regulators can be used and adjusted to different voltages, so that more resistance can be cut in with each rise of voltage.

It has been found necessary to make the contacts of carbon, to prevent the injurious arcing. The many unsuccessful attempts that have been made to regulate successfully with water power make the results attained by this device especially gratifying.



SPEED AND VOLTAGE REGULATOR.

THE ASSESSMENT OF GAS AND ELECTRIC LIGHT PLANT.

A strong deputation representing the gas and electric companies of Ontario waited upon the Ontario Government on March 14th, to urge that the street plant of gas and electric companies should not be made subject to taxation. In support of their contention the deputation submitted the following substantial reasons :

1. The business carried on by these companies, is of a hazardous nature. Under the most favorable circumstances, frequent alterations and renewals of plant are required. Their works and plant are liable to serious injury from various causes. In the case of companies using or producing electricity, and of gas companies, the depreciation of plant is specially great. New inventions in electricity are yearly being made, and plant which has cost a large sum, after having been in use but a short time, is rendered practically valueless, by being superseded by new inventions.

2. It is a mistake to assume that the business of any of these companies has been unduly profitable, and it can be truthfully asserted that the returns to those who have invested money in such enterprises, have been, and continue to be very moderate, even in the most successful cases. In many cases the returns have been much below what should have been received, and in not a few instances, there has been a direct loss. In this respect the returns from the investment in such enterprises, have been much less than those from investment in banks, loan companies and other corporations, whilst there is always the risk of the loss of the whole or a large part of the capital.

3. These companies are not free to do business where and with whom they wish, as ordinary trading companies are. They are more or less subject to municipal and legislative control, and are restricted to localities, and therefore have a common interest with the public, not an adverse one.

4. None of the companies engaged in lighting are able to oppress the public, because of the keen competition amongst themselves, and with other illuminants. The municipality in which a water company exists, has by law, the right to acquire its property and works. There is no monopoly on the part of telephone companies unless the municipalities think proper to grant them such, and in all cases in which exclusive rights have been granted, the municipalities derive a yearly revenue therefrom.

5. The present charges for gas, water, electric light and telephone service are reasonable. In many cases the companies concerned do not derive a fair return for their investment, while in some cases they are unable to meet expenses. The companies recognize the necessity of reducing rates from time to time, as much as is consistent with a fair return. If any additional burdens be cast upon them by an increase in taxation, their ability to reduce present rates would be interfered with and in some cases the result would be an increase in the rates.

6. Gas is now largely used for fuel, not only by those in good circumstances, but it is rapidly finding its way into the houses of persons in moderate circumstances. To increase the taxation of gas companies, may in some cases cause an increase in the cost of gas for this purpose, and in all cases, must postpone the reduction in the price, whereby its general use as a fuel must be delayed.

7. With regard to any proposal involving the casting of increased burdens by taxation, upon the companies in question, they submit that to do so would be an unjust discrimination against vested interests, and would check the investment of capital in such enterprises. If there is to be one general principle, upon which all property, and income derivable from property, real or personal, is assessable, then these companies must submit to such a law ; but so long as special interests, such as banks, loan companies, railways, vessels, manufacturing companies, and others to-day enjoy certain exemptions, the companies in question, with at least equal force, are entitled to claim equal consideration, and would feel the injustice of being subjected to further burdens of taxation.

These reasons were supplemented by a statement from the various interests that they would be willing to be taxed on their net income. In this way taxation would be equalized and companies best able to bear the burden would pay the most.

A young subscriber of the ELECTRICAL NEWS, who has had about two years practical experience in electrical work is desirous of finding an opening for his services in an electrical manufactory, or in default of that, electrical employment of any kind. We shall be pleased to send his name and address to anyone who may desire to open correspondence with him.

CORRESPONDENCE.

METHODS OF BOILER FIRING.

WALKERVILLE, ONT., Feb. 27, 1894.

Editor ELECTRICAL NEWS.

SIR,—I notice in the last number of the NEWS an item signed "R. B.," the writer of which gives his method of firing slack coal. I cannot agree with him on some points. In the first place he says he keeps his fire about 7 inches thick; I have fired slack coal for the last eleven years, and if my fire got 7 inches thick I would think it needed cleaning badly. I have found by experience that the thinner the fire the better as long as the grates are kept covered. Now, "R. B." says he stirs his fire every second fire he puts on; that will mix the cinders with the fire, and very soon he will be burning more coal, almost one third more than is necessary. When his fire gets a little thick if he would take a slice bar with a flat hook and run it under the fire it would force the dirt through the grates, then break the fire down and fire argued exactly the same points before the Railway Committee, at Ottawa, on several occasions between September, 1892, and very light, he will have no trouble to make steam if his boilers are large enough.

H. K.

RIGHTS OF ELECTRIC RAILWAYS CROSSING STEAM RAILWAYS.

TORONTO, March 3rd, 1894.

Editor CANADIAN ELECTRICAL NEWS.

SIR,—In your issue of March, I notice you repeat what a number of newspapers also stated, that Mr. B. B. Osler "raised a novel contention" in stating that an electric car on a highway was under same conditions and rights, as to carrying passengers, as any carriage or bus, etc. While all electric railway men quite agree with Mr. Osler in this respect, it is not a "novel contention," as a reference to the proceedings of the Railway Committee will show that Mr. A. W. Atwater, barrister, of Montreal, who was acting for the Davenport Street Railway Co. and City and Suburban Electric Railway Co., of Toronto, April, 1893, and his skill in advocating this "novel contention" doubtless gained for his clients the concessions from the steam roads that were made.

Yours truly,

ELECTRICIAN.

THE NEW BLAKE PUMPING ENGINES AT TORONTO.

TORONTO, March 16, 1894.

Editor ELECTRICAL NEWS.

SIR,—I notice a communication in the March issue of the NEWS from "J. W. R.", Hamilton, Ont., re. the new Blake pumping engines at the main pumping station, Toronto water works.

In addition to your answer to the enquiry contained in this communication, I would like to say that the new cylinders are now being placed on the pumps at the suggestion and cost of the manufacturers. The engines were not shut down from the fact that they were not considered safe, but the other three set of pumps were in good condition, and in the winter months are perfectly able to handle sufficient water to supply the city.

I feel perfectly safe in saying that these pumps are the most economical pumping engines in Canada to-day. The duty of a pump is the amount of foot lbs. that can be got for every one hundred lbs. of coal burned. Now according to a test made by Mr. John Galt, C. E. and M. E., Toronto, these pumps are giving a duty of 132,056,000 ft. lbs. for every 100 lbs. of coal burned, being in this respect fully up to the guarantee of the Blake Co. The officials of the Toronto Water Works Department must be perfectly satisfied, as I understand they have duplicated the order, the building having been prepared for two set of pumps.

I am satisfied also that neither the Hamilton, Kingston or London pumps can give any such duty as this with their present construction of steam valve mechanism. With the consent of Mr. Galt I will send to the Hamilton Association of Stationary Engineers a copy of the official test for their discussion and benefit.

I might add that this test has already been read and discussed in Toronto Association No. 1, C. A. S. E.

G. C. MOORING.

HIGH VERSUS SLOW SPEED ENGINES FOR ELECTRICAL WORK.

Editor ELECTRICAL AND ENGINEERING NEWS

SIR,—In consequence of being otherwise employed I have been unable to write in answer to Mr. Robb's criticisms of a former letter. I do not propose to enter into a technical controversy as to the merits or demerits of the high speed engines as compared with smaller number of revolutions and longer stroke ones. Most of the long stroke engines are run with a greater piston velocity than the short stroke, quick running ones. I think the commercial appreciation of one kind or the other of these engines will determine their relative position more satisfactorily than any amount of argument on the question by rival claimants, who are liable to be warped in their reasons or judgment by circumstances that do not appear in the discussion.

I stated in a former letter that I knew of many places where the high speed engines had been replaced by the slow speed ones, yet I did not know of any place where the long stroke automatic engine had been replaced by the high speed one. By your permission I will mention a few of these places, which, if space allowed, or the merits of the question demanded it, could be extended indefinitely. When first I visited the Toronto Electric Light and Power Company's works on Sherbourne street, the current was generated by five or six high speed engines; in their new works there are no high speed engines—Brown and Corliss engines made by the Polson Company taking their place. Their works are conducted by one of the best electrical and mechanical engineers in Canada, and we must assume that his judgment on this matter is correct, as the work have been a commercial and mechanical success.

The Toronto Electric Railway Company have a number of quick running Armington & Sims (United States) engines at work. They are now about to increase their power by 6000 h. p., and intend to put in engines of the slow speed type now building at Bertram's works, Toronto.

The Montreal Electric Railway Company are placing six Corliss engines of 600 h. p. each in position, two of which are now at work. These engines were built in Montreal as called for by the company's agreement with the city.

The Hamilton Street Railway Company have four automatic engines, three being Wheelock and one Corliss, the last put in being built by John Inglis & Sons, Toronto. The same makers are now building two Corliss engines for the Hamilton, Grimsby and Beamsville Electric Railway, and have placed two in position for the Kingston Electric Light and Power Company and one in Gananoque for the same purpose. So far as I am able to judge without prejudice one way or the other, I do not think any high speed engine in Canada can approach these for economy of fuel, oil and attendance.

The London, Ont., Electric Light and Power Company have up to a recent date run with high speed automatic engines. Recently they have put into operation two compound Wheelock engines. The Leamington Electric Light Company have also replaced their's by a long stroke engine—the manager told the writer with a reduction of one third on their fuel bill.

The Montreal Electric Light Company also had high speed engines; they are at present running with larger and economical slow speed ones.

I will not continue this list as your space forbids. The tendency of modern electrical engineering is towards larger generators and slower speeds. With regard to the high speed economical engine referred to by Mr. Robb, I assume he means the engine designed by the late Mr. Willans, of London, England. All Mr. Robb has stated in his letter has been claimed for the Willans centre valve engine, the facts of which I would not for one moment deny. I have a sectional elevation of this engine in its latest form; it is a tandem vertical triple expansion one designed for 160 to 180 lbs. steam pressure, has nine steam cylinders in three vertical rows, high, intermediate and low, acting on three cranks on the down stroke only. The central valve which distributes the steam on each side of cylinder is worked from an eccentric turned out of the solid on the centre of each crank pin, and connects to the valve through the centre of the piston rods, or what answers as a piston rod. The work on this engine is of the most elaborate description and could only be done by special tools adapted to the purpose, as all joints and surfaces have to run steam tight without packing. The greatest care would also be necessary in running them, as any want of oil or foaming steam might ruin them.

These engines are very costly, very much more so than the same power would cost say of the Corliss design, and without any more economy. They would also be shorter lived as to their wear and maintenance. They are, however, sold to the navies of the world for electric purposes through the small amount of space they occupy for power and light developed.

In my letter I referred to the Armington & Sims engines running the electric light at the Parliament buildings at Ottawa. Mr. Johnson, who has charge of the electric plant there, informed me that they burned 4½ lbs. of coal per 1 h. p. per hour. Since I wrote you I have been employed to test an Armington & Sims engine built by Messrs. Nye & Whitfield, of Hamilton, two boilers built by John Inglis & Sons, Toronto, and the electric installation by the Kay company, Hamilton. I will condense my remarks by stating that a careful trial gave the following results:

The engine was 6 x 8, making 336 revolutions per minute, which speed was practically maintained under all loads. It ran with great smoothness loaded or light. The power developed taken from the diagrams—14.85 h. p.; the coal burned 3.78 lbs. per indicated h. p. per hour; ten, 16 candle lights per 1 h. p.; thirteen do. per electrical h. p. There was no sparking at the commutator and very little heat of armature or field windings.

I have thought it my duty to mention this in justice to those engaged in building this class of engine. This plant is in the Bank of Hamilton, Hamilton.

Although this result is a good one for a small engine, it is a long way off what can be got out of a Corliss compound or an equally good engine of any other design running at slow speed.

I have read with much interest the communication from the stationary engineers on boiler setting and kindred subjects. I agree with your correspondent, Mr. George Gilchrist, as to his idea of the form behind the bridge and space from the fire bars to the boiler. The distribution of the heat on this plan will be equalized on the bottom plates and not concentrated on one spot. In your next number, by your consent, I may be able to throw some light on boiler construction that will occupy the attention of those interested. Allow me to congratulate the stationary engineers on the educational work they are doing in raising their members to a higher plane in their business. The result should be a public and industrial benefit.

Yours respectfully,
J. H. KILLEV.

Hamilton, March 14, 1894.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of the various Associations are requested to forward to us matter for publication in this Department not later than the 20th of each month.

TORONTO ASSOCIATION NO. 1.

At the regular meeting on Feb. 23rd, Mr. W. J. Hursley was initiated and propositions for membership received from Mr. J. Marr, of the Incandescent Electric Light Co. and Mr. Meacham of the Don Valley Pressed Brick Co.

A committee was struck to look into the by-laws of the Association and make a report thereon after a discussion had taken place on the meaning of one or two clauses which some of the members objected to.

Mr. Gilchrist promised to read a paper at the next meeting on "Shafting." Mr. McLaughlin also promised a paper in the near future on "How to Run an Electric Plant." The question box brought out the following query—"What is the greatest percentage of strength of joint compared with solid plate which it is possible to make in constructing longitudinal seams of steam boilers?" Mr. Edkins answered as follows:—A double strap butt joint with eleven-sixteenths of an inch thickness of steel plate and eleven-sixteenths of an inch diameter of rivet, pitch 4.56 inches, straps .52 of an inch thick, will give a percentage of strength of 84.9 compared with the solid plate.

At the regular meeting on the 9th of March the initiations of John Marr and Mr. Meacham took place. Two more propositions for membership were received. Brother Bredinias in a short speech bade farewell to the members as he is going away from Toronto to take charge of the Napanee paper mills. Mr. Gilchrist in a letter stated that owing to illness he was unable to get to the Association to read his paper on "Shafting," therefore it was postponed to a future meeting. Mr. Wickens read the proposed amendments to the Act relating to engineers, now before the Ontario Legislature. A long discussion took place thereon. Many of the members gave their views for or against the measure; several took petitions in favor of licensing engineers with them to obtain signatures from their fellow workers.

CHAS. F. KINSEY,
Corresponding Secretary.

WINNIPEG ASSOCIATION NO. 11.

Following are the names of the charter members of the above Association: Chas. E. Robertson, Luersidge Brandon, Thos. Gordon, Wm. Kennedy, John G. Kemp, Ed. Doran, John Stanley, James T. McDonald, John Harrison, Dan Doran, Thomas Grant, Ed. Alberg, Chas. R. Forge, Arthur Harper, James Albert Binns, Michael J. Sanders, J. R. Alexander, W. F. Brown, Thos. Hanes, Robert Hall, James Stuart, J. W. Schneider, R. Douglas, Amrud Schmidt, Robert Sutherland, Thomas Brown, Thomas Dalziel, James Whyte, J. B. Crawford, Geo. M. Hazlett, Jos. Mills, Wm. Drever, Alex. Leighton, John Whittacker, Frank Thompson, D. Ramsay, W. C. Holder. The Association has elected the following officers: President, Chas. E. Robertson, Dominion steamboat inspector; first-Vice President, James Whyte, chief engineer Ogilvie's mill; second Vice-President, G. M. Haslett, Northwest Electric Light Co.; Recording Secretary, L. Brandon; Financial Secretary, Arthur Harper; Treasurer, James Stuart; Conductor, Walter Alexander; Doorkeeper, W. L. Brown, engineer Clarendon hotel. At the second meeting eight additional members were received into the Association.

OTTAWA ASSOCIATION NO. 7.

Editor ELECTRICAL NEWS.

SIR,—I have pleasure in saying that Ottawa No. 7, although one of the baby Associations, is not taking a back seat in the way of increasing its membership, which is due to the remarkable good will and activity of its members. Interesting meetings is what brings members, and the instruction received at each meeting is what adds to the membership.

As stated in my last letter, we were favored with Bro. Latour's paper on the "Steam Indicator." Before entering into the details of the indicator he explained how heat could perform a relative quantity of work after being converted into steam, which is a medium of conveying the heat into the cylinder in which the motion of the piston converts a proportion of heat into work. After referring to different ways of measuring the work done by an engine he proceeded to show that the only accurate one was by the indicator. By blackboard illustration, a diagram similar to one made by the instrument showed very clearly even to the unexperienced how to discover if the valves, either steam or exhaust, are working as they should when correctly adjusted. The engineer of the present, he said, began to realize that the indicator and the understanding of its diagram was an absolute necessity, for no man could conceive what took place in the cylinder without its use. For example he used some cards taken from his engine, which is compound condensing; whilst showing the defects of admission, steam expansion, exhaust, back-pressure, and compression lines, and how to remedy the faults, some half a dozen or more cards were vouchers for the improvements on his engines, and the difference as Bro. Latour said, was very worthy of note, for with the same steam pressure and load the speed was increased by 12 revolutions per minute. The next question of importance was: should a steam dome be single or double rivetted to the shell? I may say here that our new mode of procedure in dividing the meeting on the subject taken, has revived more than ordinary interest in bringing out the two sides of the question and at the same time training the members to debate, for it is a well-known fact many a good engineer has an opinion but cannot very well express it. Bro. Robert conducted the affirmative or single row, and Bro. Latour the negative or double row. Bro. Donaldson, of Toronto, was appointed judge.

Bro. Latour opened the debate by saying that the two rows of rivets were preferable for many reasons, first, that the cutting of the plate under the dome weakened it to such an extent that it needed reinforcement and that the additional width of joint strengthened that part of shell to a degree that should not be left out of consideration. He also referred to the uneven and trying strains on that neutral part of shell under the dome.

Bro. Robert took the stand and contended that if it was necessary to strengthen any weak part of the shell there were many ways to do it either by having stays or bars of tee irons as the case might require. By making a rough sketch on the blackboard he showed how to stay that part of shell, if necessary, by calculating the upward pressure on any size dime and also the tensile strain on the rivets. It was argued that since one row of rivets was more than sufficient to resist the upward pressure, there was no necessity of having the shell weakened by the additional holes required for two rows of rivets, and furthermore the extra labor and material meant extra cost and nothing in return for it. After the other members had been heard from on both sides of the question, Bro. Donaldson decided that the weight of argument was in favor of the affirmative or single row. A vote of thanks was tendered Bro. Donaldson for acting as judge and taking such a general interest in the welfare of engineers, after which the meeting closed to be reconvened on the 13th of March.

A few meetings ago Bro. Hill directed our attention to a paragraph in the daily papers stating that His Excellency, Lord Aberdeen, the Governor General, had many times stood on the foot plate of a locomotive in the Old Country and was thoroughly acquainted scientifically and practically with the science of engineering and took much interest in the modern steam engine. In view of this, Bro. Hill suggested that our Recording-Secretary be instructed to write asking His Excellency to extend His Patronage to Ottawa No. 7, C. A. S. E. It is needless to say that every member present at the meeting on the 13th of March was highly pleased to learn that a favorable answer had been received from His Excellency.

The following resolutions were adopted at the regular meeting on March 13th.

Whereas, it has pleased Almighty God in His infinite mercy and goodness to remove from our midst the beloved and affectionate daughter of our esteemed Bro. J. H. Thompson,—therefore

Resolved—That we the officers and members of this Association do sincerely sympathize with our brother and his family in this their hour of affliction, and be it further

Resolved—That it is but a just tribute to the memory of the departed to say that in regretting the removal of this loving daughter we mourn for one who was in every way worthy of our most profound respect, and be it

Resolved—That a copy of these resolutions be transmitted to Bro. J. H. Thompson as a token of our respect and veneration, and that they be spread upon the records of our Association and published in the ELECTRICAL NEWS, Toronto.

Committee { FRANK ROBERT, Pres.
J. O. B. LATOUR, Rec. Sec.
THOMAS WENSLEY.

Yours truly,

Ottawa, March 19th, 1894. PROGRESS.

WORK OF THE EXECUTIVE.

Mr. John J. York, Executive Secretary, writes as follows; The last month has been a very busy one in this office. Some time since we opened correspondence with Mr. Chas. C. Robertson of Winnipeg, who, by the way, is an honorary member of old Montreal No. 1, the result of which has been the foundation of an association in that city under the most favorable circumstances, there being 39 charter members, and I have to-day received word that they admitted eight others at their last meeting. It has created quite a stir among engineers in that city. I enclose you a list of the charter members and also a list of the officers of this new association to be known as Winnipeg No. 11.

A short time ago Bro. A. M. Wickens, of Toronto, paid a visit to Kincardine, and his labor has already borne fruit, as I have to day received an application for a charter signed by the following well known engineers: John Cress, Daniel Bennett, Percy C. Walker, John Gillespie, Andrew Beadle, Andrew T.

Scott, Sam. McClure, Jos. Walker, John Campbell, Percy Ashton, Andrew Scott. This will make the third charter issued this year, and there are good prospects of others coming in. I am expecting every day to get news from Sherbrooke, P. Q.; there are a fine lot of engineers there who stand high in the profession, and if they will only form a branch of the grandest of all educational societies they will find it greatly to their gain. There are other towns in Quebec and Ontario that I am sure only need to be shown the great advantages to be derived from the C. A. S. E., when they will at once form themselves into branch associations. The Souvenir of the Fourth Annual Convention gotten up by Montreal No. 1 has been handed over to the executive to be run in the interest of the whole Dominion. I am at present getting out circulars, etc.

AN ENQUIRY.

Editor Electrical News.

Dear Sir :—When are the new associations at Sherbrooke, St. Johns, Montreal, &c., in the Province of Quebec going to materialize? I presume I should address this query to the President of the Executive Council, Bro. Geo. Hunt, of Montreal. One of our members was down in Montreal last October, and when he returned he informed us that Bro. Executive President Hunt was going to organize some new associations in the Province of Quebec. We have been waiting in vain to hear of this being done, but have been disappointed. Come friend Hunt, bestir yourself, we want to see an addition of 100 per cent. to the members of the C. A. S. E. when the convention meets next year.

Yours truly, Engineer.

GROWTH OF THE ASSOCIATION.

139 Borden St., Toronto, March 23nd.

Editor Electrical News.

Dear Sir :—It will interest many of your readers, particularly those of them who are members of the C. A. S. E., to know that there is every likelihood of there being a very substantial addition of new associations especially in the Province of Ontario. I have just returned from a trip on the G. T. Railway east, during which I attended a meeting of Engineers in Peterborough, at which it was decided to form a branch association there and apply for a charter immediately. Steps are also being taken to form associations in Belleville and Brockville. At the time of writing I have in my possession the charter for a new association at Kincardine, Ont., which will be known as Kincardine No. 12, C. A. S. E.; I have also an application for a charter from Wiarton, Ont., this charter will be issued in the course of a few days. There are daily enquiries regarding the C.A.S.E., and also the examinations of the Ontario Association, which goes to show that the engineers of Canada are working up all round, and are beginning to appreciate the work of the Association. I firmly believe that when the convention of 1894 meets in Toronto in September next, we shall be in a position to present a statement showing that during the présent year there has been an addition of new associations far outnumbering that of any previous year.

I am just in receipt of a letter from Bro. J. J. York, our enterprising Secretary of the Executive, who informs me that he has just issued a charter for a new association at Winnipeg. I am in receipt of a letter from Bro. Jas. Stuart, engineer winnipeg Electric & Gas Light Co., who is a member of the new association there, asking for information regarding the educational work of the C. A. S. E. It is evident he intends the Winnipeg association to start aright, and wishes to benefit by the experience of the older associations. To use a common pharse the C. A. S. E. is booming, and there is every likelihood of the boom lasting. The Ontario Association is also doing well, and a large number of engineers are applying for examinations.

Yours very truly,
A. E. Edkins, Prov. Deputy, Ontario.

QUESTIONS AND ANSWERS.

J. Fielding, Hamilton, Ont., writes : I am looking into electricity. I am puzzled to know what prevents the armature from going around. Men around the dynamos say it is magnetism. I cannot see how the magnetism reaches out from the field and puts as it were a break on the armature when nothing touches it but the brushes. I cannot conceive how a space containing nothing visible can have a something in it that takes in some instances hundreds of horse power to overcome. I once saw a dynamo short circuited. The belt an 8 inch one, slipped on the dynamo wheel and the engine, a 50 h. p. one, was fetched up standing. I do not want to be told that magnetism does this. I want to know how and by the aid of what it does do it, as I cannot see anything connecting field and armature.

Answer.—If Mr. Fielding ever handled a five cent magnet from a hardware store in his youthful days he surely must have noticed that it exerted an attractive force which could be felt at some little distance from the magnet, although nothing tangible intervened. He cannot understand how anything can be there because he cannot *see* it. Did he never feel the gentle breezes of heaven wafted over his classic brow, but did he see them? Will he not believe anything unless he sees it? Did he ever see the bark of a dog? The field magnets of a dynamo when in operation are very powerful and exert a retarding effect upon the armature but when we are asked what this magnetism is, we give it up.

TORONTO TECHNICAL SCHOOL.

There can be but one idea with references to the usefulness of technical schools, and we believe that the majority of the people in civilized countries hold to that idea, namely, that when managed by competent bodies of men forming the board of management, with zealous instructors, duly qualified, under them, nothing could be of greater advantage to the mechanic, anxious to obtain an education in his particular trade, which he could not possibly obtain without them. When in addition to the facts that a technical school exists in any city, and is well governed and managed, the instruction is given absolutely *free*, the boon to the working man is simply immense. That a man should be able to acquire not only an insight into, but a thorough training in the science of his trade by diligent attendance three or four nights a week in a well lighted and well ventilated building, listening to the instruction given in a manner suited to his ability to grasp it, must be regarded as a very valuable privilege, and men who will not take advantage of all this, must be considered drones of their class. But everything in the success of such an institution must depend upon the zeal of the board of management, and the ability of the instructors. The board of management must be composed of men who are to a greater or less degree experts in the branches they represent; they must be men who will throw themselves into the work of the institution with zeal and unflagging interest, who will carefully watch their several departments and see that those who come up for instruction are receiving all that the school is able to give. Under them must be a supervisor or head master, who is responsible for the direct managament of the school, and while capable of taking occasional classes himself, must be able to know that all the other classes are well managed, that the teachers are doing a thorough work and are able to impart instruction.

The teaching staff must not only be persons who have passed qualifying examinations and are experts in their particular lines, but they must have the *faculty of teaching*, which is by no means possessed by every one who may be considered an expert in a particular science. Necessarily, of course, they must have a love for teaching, and the ability to guage the minds of those who come to them for instruction, and be readily able to grasp the meaning of the duller students who have difficulty in expressing their needs succinctly. Patience is a gift that must be possessed by all teachers, and then with a love of the subject and a desire to infuse into the students an equal love of the subject, the qualified expert will be a successful instructor.

We have in Toronto a technical school the general working of which is little known to the public. It is in its infancy, and much that such an institution desires to accomplish, is necessarily beyond the means in hand at present. But it speaks well for the school that the attendance has already become too large for the rooms now occupied, and the work done by the students such as is of a character that can be exhibited, is very creditable to the institution.

The Toronto Technical School has a board of management composed of the Mayor of the city, the chairman of the Executive Committee and three aldermen, ex officio members; two experts in technical education ; two stationary engineers ; two members of the Council of the Ontario Association of Architects ; one manufacturer, and five representatives of the Trades and Labor Council. Of the technical staff, the head master, Mr. Duff, and one other, are B. A's. and graduates of the School of Practical Science ; one other is a graduate of the same school ; one is a B. A., another a B. A. and M. C., while another is a member of the Ontario Association of Architects, and another a lady, is a B. A., and holds the position of Public Analyst.
on the necessity of proper qualification in the instructors of a school such as the one in question. It may be said that something of the same importance must attach to teachers in all schools, but there is even a greater necessity in an institution of this kind because it is not rudimentary work that is here studied, but work that cannot be successfully carried out but by eminently qualified teachers. Mechanics, chemistry, physics, mathematics, descriptive geometry and drawing cover a wide range of

We have given these particulars because of our insistence up-
technical study, both theoretical and practical, starting at a point considerably in advance of the highest grade of public school instruction and stretching forward to an indefinite grade of study in science. One of the important points for first consideration therefore must be : what shall be the highest limit of the instruction given in a particular school. This must be decided by two things : first the amount of funds at disposal for the purchase of apparatus and appliances, and secondly by the requirements of the majority of the students likely to attend. There must be some limit, or the theorist might carry on his course over several years and a great deal of time would be spent in mere speculation, while in practical matters it would be a mistake to go beyond the recognized requirements of particular trades. It has been found necessary to treat in an elementary manner upon some subjects, such for instance as arithmetic and mensuration. A student would profit little by the most excellent instruction in mathematics unless he had a certain fluency in arithmetic, and as most students coming first to the school, have passed some years since they left the public school their arithmetic, except in very simple matters, must necessarily be "rusty" even if they ever learned enough "at school" to enable them to take up the higher branches. Descriptive

geometry and drawing cover, perhaps, a larger field than any other subjects, from practical geometry, drawings of constructions in all trades, the setting out of carpenter and joiners' work (some of which is necessarily indicated) drawings for pattern makers for machinery, up to free hand, ornament and design, and even architecture. Thus this subject illustrates, in a way, the importance of a thoroughly qualified instructor.

Another very important point to which a Board of Management must be thoroughly alive is, that having satisfied themselves with the *qualifications* of the teaching staff, they ascertain from time to time that the teachers are making progress themselves and keeping abreast of the times. It is very easy for an instructor in any subject to "get into a groove" or even to become careless in the preparation of his lectures; the problems he propounds must be progressive and must carry with them important lessons; and again these problems must be suited to the various stages at which the students have arrived. A problem may be in every respect a very excellent one, but if it goes beyond the instruction given, or does not come up to it, it is valueless, for in the one case the student will work it out with the greatest ease as belonging to a stage he has passed, or in the other, it will be a waste of time for him to puzzle over something about which he has not as yet received full instruction. It has been said that the guarantee against failure, in this respect, on the part of the instructor would be, that the students would themselves complain that they did not obtain that which they found of necessity to them. But it must be remembered that the majority of students, probably, would not have sufficient ability to detect any weakness of this kind in the teacher, and few would like to take upon themselves the responsibility and the great unpleasantness of making a complaint. The consequence would be, that one or two, who felt this, but did not see how to help themselves would leave, while the majority would remain and waste their time under the impression that they were progressing. Examinations of students to ascertain their progress would not mend matters or be a sufficient guarantee in the matter. This work of keeping the instructors up to the mark would, we suppose, devolve upon the two experts in technical education. These two experts are Prof. Galbraith and Dr. R. B. Orr, and we find their names head the list of the "School Management Committee." In these two gentlemen we think the public have a thoroughly satisfactory guarantee in this particular.

One point which concerns the public generally more perhaps than any other, and vitally concerns the institution itself, is the salaries paid to the instructors. The suggestion of reduction of question of salaries is now occupying the attention of the Board of Management. Every institution in its infancy, to be a success, must be carried on on the most economical principles consistent with the objects to be attained. An institution of the kind in question requires a large number of appliances for the execution of its work, as well as competent instructors, and the instructors must necessarily be hampered in their work without a sufficiency of appliances. When the appropriation for the work of the school is limited, it becomes a nice question as to what proportion shall be spent in salaries and what in the purchase of appliances, having first deducted from the appropriation the current expenses, such as rent, fuel, light, etc., etc. It seems to us that the subject has not received the attention it deserves at the hands of the board of management, and that the principle in force in the technical school of Toronto is an easy one of disposing of a difficult question, but that it is open to question as to whether it is very fair to the instructors themselves or altogether judicious in view of the limit of the appropriation. We do not for a moment agree with undervaluing the services of qualified teachers, but the point is one of utilizing the funds to the utmost advantage. Out of an appropriation of $7000, $4000 is divided equally among the eight instructors, no difference being made between one who has to spend a large amount of time in necessary preparation of his lectures and one whose subject being practically book work, does not need much time for preparation—between one whose subject is endlessly progressive, and one whose subject is by very nature, a limited science. In the first place $500 seems a large sum for an instructor who having the whole day for earning his livelihood, puts in say three nights a week for about six months of the year, and has little or no preparation to make for his class work at the school. But it does not seem too much for one who has to put in five nights a week for the same time, and has to spend two or three hours a day besides in preparation, even if he is an expert, and thoroughly posted on his subject.

In this institution the principle is that the work of instruction is to be divided up as equally as possible among the eight instructors, and if one has more than he can do in one subject, he must get the assistance of one whose time is not so fully occupied, so that the time of each shall be equally employed and all receive the same remuneration. But is there not a weakness here? The expert in one science is not likely to be an expert in another. If the instructor in drawing had too much on his hands, he could hardly obtain assistance from the expert in chemistry, or the expert in chemistry from the teacher of mathematics. While we do not advocate the reduction of salaries as an all round principle, nolens volens, we think that there would be a decided gain to the institution if the matter were regulated in a rather more practical manner than at present.

The limited space at command of the institution should make the matter of admission to its benefits, one of some consideration. At present any applicant (unless something serious is known against his character for instance) is admitted. A youth may think it will do him good to attend certain classes and he applies for admission; he attends a few nights and "drops out"; another may find it a pleasant way of spending a few evenings a week, taking up much valuable time of the instructor, and learning nothing, or one may come to learn, for example freehand drawing, not for the purpose of improving himself at his trade, but simply as an accomplishment. Thus, the space being limited, these three would shut out others, worthy seekers after knowledge as a means of improvement in their trades, for whom we conclude the institution is primarily intended. Now that the two dollar deposit, originally demanded from an applicant is not required, there is absolutely no guarantee of serious intention on the part of the applicant. Some kind of enquiry should, we think, be made concerning the applicant before admission is granted, of a fuller scope than is supplied by the simple form of application.

There is one other point upon which we wish to touch, that is examinations. The institution, like all others in their youth, cannot be expected to produce in the short time that it has been at work, very great results, and the public should not be disappointed that experts are not turned out at the close of every term. The work is necessarily progressive, and a certain course must be taken (in some classes of two years duration), before the ground is covered. There are certain disadvantages perhaps in permitting each instructor to examine his own class, but there are many advantages, and on the whole this principle really has proved in the majority of institutions to be more satisfactory than the employment of "outside" examiners. The "outside" examiner is generally or should be necessarily an expert among experts, but he has no intimate knowledge of the students he has to examine. Consequently he looks over the work through which the students have waded in the term, concludes that they have reached a certain standard, and he possesses certain or if we may say so, stock or test questions, which, if every student was of the same mental calibre as his neighbor, would no doubt test their abilities very well. But in all classes, there are some students brighter than others, and some who cannot by any means grasp a subject so easily as others. Moreover every examiner knows that many a student fairly well posted in his subject and who has shown great diligence at his work may fail completely at an examination through nervousness or the inability to comprehend the exact meaning of the questioner; while it may happen and has happened that a student may be acquainted with the peculiarities of a particular examiner and come out with flying colours at an examination who really was not so well grounded as the former example. There is a difficulty here that is not easy to get over in the way of satisfying the public that the results of the work are commensurate with the appropriation. A certain amount of result may in some branches be seen, as for instance in the exhibition of drawings executed by students, but even this is not satisfactory, for if a student exhibits a beautiful drawing of an elaborate machine, the public cannot know from the drawing that the student has an accurate knowledge of the use and working of every portion of the machine. A knowledge of algebra and such sciences cannot be exhibited, nor can the result of a two years course of chemistry be practically demonstrated to the public mind. In this matter the public must trust to its representatives on the board of management. The duty of the public to themselves is to see that the best men for the positions are elected to fill these offices and the public may and should scrutinize carefully the work done and the attention given by each member of the board.

A visit to the institution satisfies us that so far as it is able to go, the lines upon which its work is based are very excellent. It is a school worthy of a much larger appropriation, but the foregoing suggestions with reference to improvement in management present themselves, and are worthy we think of investigation.

Our thanks are due to the very courteous reception we met with at the hands of Mr. Duff, and the pains he took to give us the fullest information concerning this valuable institution.

THE MAGNOLIA METAL COMPANY'S ENORMOUS SALES.

The business of the Magnolia Metal Co. in its sales of Magnolia Metal, has increased 12% from January 1893 to January 1894, over the sales of the previous year, notwithstanding one of the greatest panics that the world has ever seen, passed over the country during that time.

The factory of this company has never closed down for one day on account of the panic, and a part of the time it had to run all night in order to keep up the company's orders for Magnolia Metal.

The outlook for the coming year of 1894 is very bright, and the Magnolia Metal Company anticipates an increase of at least 50% over the year 1893.

Meetings of property holders and others interested in the construction of an electric railway from Montreal to Lachine have recently been held, and a general committee appointed to preface a plan of the route, and report at a future meeting.

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Correspondence is invited upon all topics coming legitimately within the scope of this journal

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Information regarding examinations will be furnished on application to any member of the Board.

A LARGE number of the citizens of Toronto petitioned the Ontario Legislature to define the intervals at which a vote on the subject of Sunday street cars should be taken, and to provide such safeguards as would insure the taking of an honest vote. The Legislature by a vote of 17 to 18 decided that a vote may be taken every four years, the first vote not sooner than 1896. It also decided that when such vote shall be taken, manhood suffrage shall prevail.

THE New York State Department of Public Works is reported to have granted an electric company a fifty years' franchise for the construction of an electric plant with which to propel canal boats. A condition of the franchise is said to be that the company shall not charge boat men more than $20 per electrical horse power for each season of navigation. This price it is said is 50 per cent. less than the cost of animal power. We have already referred to the fact that successful tests have been witnessed by the officials of the Department of Railways and Canals at Ottawa, of apparatus designed to operate electrically lock gates on the canals, and no doubt the experiment of operating also the boats by electricity will be tried at an early date.

THE Hamilton, Grimsby and Beamsville Electric Railway Company, who recently petitioned the Department of Customs at Ottawa to allow the steel rails for their new road to be admitted into Canada from Scotland duty free, have been notified that the Government have granted their request. The duty would have amounted to $10,125. As was pointed out recently, the wording of the tariff with regard to the duty on steel rails is ambiguous, but the action of the Government in the present instance would seem to show that rails for electric railway purposes are not considered to be dutiable. It would be desirable in the interest of all parties concerned that the question should be submitted to the courts for decision at as early a date as possible.

RUMORS have been circulating for some time past to the effect that an electric road is projected between the cities of Toronto and Hamilton. There is a very heavy traffic, both of passengers and freight, between these points, and without having considered the matter in detail, it would appear on the surface as though a profitable business might be done along this route. It is now certain that the extension of electric lines throughout the country in the future, will be much greater than was anticipated even five years ago. These electric roads will to a considerable extent take the place of horses and vehicles on country roads in the vicinity of large towns and cities and will also prove formidable competitors to the steam railroads for passenger and freight traffic. The "Good Roads Association" recently formed in Ontario should not lose sight of the possibilities and probabilities in this direction while seeking to determine the character of the construction of roads.

MR. D. ASWORTH closes a paper on Boiler Firing and Managament, read before the Engineers' Society of Western Pennsylvania in the following words: It would be proper to ask what degree of intelligence or knowledge would qualify one to fire boilers properly. (1). That the fires should be maintained with uniformity, and that no openings, in the form of bare places, show upon the bars to permit the cold air to pass through. (2). The judgment that will enable him, by a glance at the ash-pit, to know at once, to a great extent, the condition of the fires. (3). He should know something of the various fittings of the boilers and the details of the furnaces. (4). An ambition to grasp the details, so as to qualify him for a still higher plane, which would certainly follow, provided there was judgment enough in his superior to note such details.

A CORRESPONDENT writes us expressing his opinions in a very decided way in opposition to the granting by the Legislature of Ontario of the petition of the Ontario Association of Engineers for legislation to make it compulsory on all engineers operating engines of 15 h. p. and upwards, to present themselves for examination and obtain certificates of competency as may now voluntarily be done under the Engineers' Act. Our correspondent asserts the opinion that if engineers are to be compelled to undergo examination and obtain certificates, the examinations should be conducted by the Government and not by a body of engineers. He argues that a man who does not belong to the Engineers' Association, and who may not have the time or the disposition to become a member of that organization, would be likely to stand prejudiced in the eyes of the members of the examining board, as at present constituted, if he should be compelled to present himself to them for examination, and that it is quite unlikely that such a man would be granted the required certificate. The point of his contention is that the members of the present examining board are competitors for positions with those who go up for examination, and therefore might be supposed to be interested in withholding certificates from them.

MEETINGS OF THE MONTREAL ELECTRIC CLUB.

Feb. 12—Several of the members submitted draughts of wiring specifications for the use of architects in calling for tenders. After a lively discussion, the matter was left over till the next meeting for final consideration.

Feb. 26—Mr. J. A. Anderson read an interesting paper on "The Telephone" for which he was given a vote of thanks. The wiring specifications were then brought up for consideration and after careful discussion a particular form was adopted.

MONTREAL JUNIOR ELECTRIC CLUB.

The above Club have held weekly meetings at No 6 Richmond avenue, at which papers were read as follows:

Feb. 25th—Paper on "Incandescent Lamps," by S. W. Smith.

March 4th—Paper on "Arc Lamps," by R. H. Street.

March 11th—Paper on "Edison Three Wire Meter and Westinghouse Meter," by E. W. Sayer.

March 18th—Paper on "Induction and Induction Coils," by Wm. T. Sutton.

The address of the Secretary of the Club, Mr. O. H. Overton, is 19 Brunswick street, not Burnside street, as given in our last issue.

QUESTIONS AND ANSWERS.

SHERBROOKE, P. Q., March 9th, 1894.

Editor ELECTRICAL NEWS.

Sir,—There is a discussion going on amongst the men in our electric station in connection with our arc light circuit and dynamos. We have a circuit with 65 arc lamps from two Ball dynamos, 35 lights each. We find that by connecting the two dynamos, we get a steadier current on our lines. Each lamp takes say 50 volts, and for 65 lamps makes 3250 volts. The discussion is: are there 3250 volts pressure on each dynamo, or simply each dynamo exerts an E. M. F. only equal to its own capacity, whatever it may be built for, or whatever number of lamps up to its capacity may be in use. I trust you will understand what I wish to get at.

Yours very truly,
A. SANGSTER,
Supt. Sherbrooke Gas and Water Co.

ANSWER.—The tension in each dynamo is that due to the electromotive force it is generating itself; the total electromotive force in the circuit is that due to the sum of the combined machines.—[ED. NEWS.

The annual meeting of the shareholders of the Victoria Electric Tramway and Lighting Company of Victoria, B. C., was held a few days ago, at which the annual report and financial statement was presented. The report showed the company to be in a prosperous condition. Mr. T. S. Gore was elected a member of the Board of Directors to fill the vacancy caused by the resignation of Hon. D. W. Higgans. The other members of the Board were re-elected. At a subsequent meeting of the directors, the following officers were elected: President, C. T. Dupont; Vice-president, Dr. T. J. Jones; Secretary, T. S. Gore; Auditors, Messrs. Raymur and Berridge.

ABOUT PACKING.

If the rod is in first-class condition almost any kind of packing will answer the purpose, but where it is scored or worn tapering, or is out of line, we must use a packing that will follow up the inequalities in its travel, and to do this without excessive friction the packing must be very elastic. The following plan is a very good one, says the American Machinist.

Suppose that the stuffing box is 4 inches in diameter and the rod is 2.5 inches, leaving a space three-quarters of an inch wide to be filled with packing, and assume that the stuffing box is 3¾ inches deep. Take a piece of pure gum rubber sheet packing, without cloth insertion, which is one-quarter of an inch thick, and cut a piece from it 3 inches wide, and of such a length that when it is rolled up into the form of a circle, it will form a bushing for the stuffing box, reducing the space around the rod to ½ inch in width. Care must be taken to cut this so that the ends will meet squarely, leaving no space between them, for this bushing of rubber must be a perfect fit in order to be effective. Next take a piece of firmly made packing, which is ½ inch square, and cut rings enough to pack the rod out flush with the rubber bushing, which we made 3 inches deep, thus taking six rings. These rings should be of such a length that when they are in place there will be at least ⅛ inch between the ends. They must never be cut so as to make a tight fit, although it makes a neater looking job in that way, for, unless there is room for the rings to expand, ths heat will cause excessive friction, sometimes to the extent of burning out the packing and scoring the rod.

We have left a space ¾ inch deep, which is sufficient for the gland to enter, but the nuts which hold it in place should not be screwed up with a wrench, but with the fingers only. If there is a leak of steam when the engine is started, it will do no harm for an hour or two, but if the expansion does not take it up then, the nuts may be screwed up until the joint is tight, but no further, for obvious reasons. If packing put in according to these directions does not abolish the disagreeable hiss of steam at each revolution of the engine, I do not believe that any other kind of fibrous packing will do it, and the rod should be turned true and put into line.

So far as flange joints are concerned, it is a very good plan to have them ground so that no packing will be required, but as many of them are not built that way, it remains to select the packing which will render the best service. If the steam is not saturated with oil, we may select any elastic grade that is most convenient, but the flanges of the throttle valve, and any other that may be deyond the lubricator, must be packed with something that will not be dissolved by the oil. A corrugated copper gasket for each of such joints will answer a very good purpose, unless the faces are very rough. If we are to use soft packing, it is well to take a small piece of it, and put it in a cup of oil, and let it remain for about a week. There are several kinds in the market that will not stand this test, for when taken out there will be but little left of them, as they will be either partially or wholly dissolved, but others will be just as good as new after the test, and these should be used exclusively.

Flange joints, when newly packed, should not be suddenly subjected to a heavy pressure, but should be warmed up gradually, and while still under a very light pressure, the nuts should be carefully screwed up until all of the lost motion caused by the relaxation of the packing is taken up. Under no circumstances is it proper to screw up these nuts under a heavy pressure, for if one of them should fail, the additional strain thrown on the others might cause them to break, and a serious accident would be the result.

In making up these joints do not begin on one side and screw up the nuts in rotation, as that will cause the flanges to be brought together on one side, and thrown open on the other, and then when this side is tightened up also, if it does not break the flange, it will cause a very heavy strain to be brought to bear on the bolts, much of which is entirely unnecessary.

In using old bolts for this purpose, they should be put in a vise, well oiled, and the nuts run down on them, until it is known that they are an easy fit a little farther down than they will ever be needed when in place. If this precaution is not taken, it is quite possible for the bolts to be twisted off before the flange is together properly.

In packing a cylinder head it is not necessary to have a large rubber gasket, as some asbestos wicking will answer every purpose at a very low cost. In packing a large valve stem, which is worn down, or has been turned down until it no longer fills the hole in the bonnet, a washer or gasket cut from thick pieces of cloth-insertion sheet rubber packing will answer a very good purpose, if put in first, or if the gland is a loose fit it may be put in last, to prevent the wicking from working into the space around the stem.

The Mayor of Bracebridge, Ont., has been requested by the Council to correspond with electric light companies regarding an electric light scheme.

The City Council of Victoria, B. C., has passed a by-law authorizing the issue of debentures to the amount of $50,000 for the purchase of an electric light plant and the erection of a building for the same. The by-law is to be submitted to the ratepayers.

The claim of the City of Toronto against the old Street Railway Company for the sum of $146,000, being the cost of certain local improvements for which the company is alleged to be liable, is at present occupying the attention of the Supreme Court at Ottawa.

PRACTICAL HINTS TO ENGINEERS ON THE MANIPULATION OF DYNAMOS AND ELECTRICAL PLANTS.*

By James Milne.

Mr. Chairman and Gentlemen :—I don't propose to go elaborately into the technical or mechanical construction of dynamos and electrical plants in general, but for those who may not be sufficiently informed as to the manipulation of dynamos or plants under their charge, I simply wish to assist them as far as is possible to do for the short time I am here.

Engineers, as a rule, wish to get to the bottom of things, and like to know how this is done, how this is arrived at, who invented this and that and the other thing, and I think they are perfectly justified in finding out everything pertaining to the machinery they are in charge of, whether electrical or mechanical. A man is certainly a very poor tool indeed if he is in charge of any machinery and does not know thoroughly both the practical and theoretical workings of same, and he is certainly a great deal worse, knowing where he is deficient, if he does not strive to get the requisite information.

I am sorry to state, in quite a large number of stations and plants I have had the pleasure of visiting, that the lamentable ignorance displayed by those in charge of dynamos or running same, is about the first thing that attracts one's attention; in fact, you would wonder sometimes how they pulled through. If the question is asked, "How is the current generated?" &c., &c., you get an answer, but what sort of an answer is it? It is one of these that you feel sorry for the party endeavoring to disentangle himself from the labyrinth he has worked himself into. If he had said that his knowledge on that point was limited, there would have been some excuse, but it would not do under any consideration whatever to let a visitor to his plant think that he did not thoroughly understand the workings of same.

A man should be able to think for himself, and if he depends on some one else doing the thinking for him all the time, he will never make much headway in the world. I don't mean by this that one should be above asking a question, or seeing how things should be done, but see that you thoroughly understand why or how it is done—this way or that way, as the case may be—and try and avoid if possible doing it this way because you saw some other party doing it, unless you comprehend just why it was done in that manner.

Let us now come to the more interesting part of our paper. Faraday about 1831 discovered that electric currents were generated in conductors by moving them in a magnetic field. Let us see what that means. When a conductor is moved in a field of magnetic force in any way so as to cut the lines of force, there is an electromotive force produced in the conductor in a direction at right angles to the direction of motion and at right angles also to the lines of force as received from the point from which the motion originates. By examining Fig. 1 it represents the case very clearly. The conductor is marked C, the direction of the current is indicated by the fore finger, the direction of motion or rotation is as shown by the middle finger, and the direction of magnetic force is indicated by the thumb.

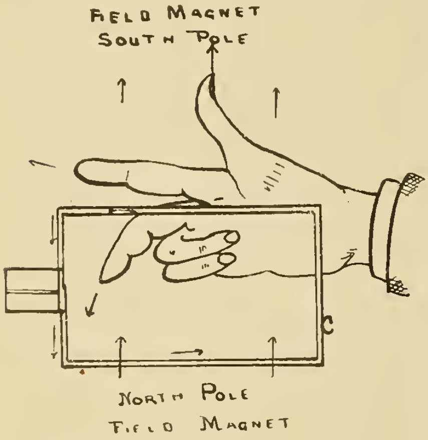

Fig 1

A dynamo can be made to run as a motor just as efficiently as when running as a generator. The only alteration that is required is to cross the brush leads in series and compound wound dynamos. The shunt wires in the latter have also got to be crossed. In shunt wound motors no alteration is made on the brush leads.

It is quite possible in running electric light plants, when quite a number of generators are in parallel, to run a dynamo as a motor and scarcely know it. This does not mean, however, that the brush leads have got to be altered, for a dynamo in a station will run as a motor without any alteration with wiring whatever. Suppose one dynamo is running, say, at 110 volts, and it is found necessary to couple in another one with it—just the same as if we had one boiler at 110 lbs. and the load getting too heavy for same, and we wish to cut in a second one. If the pressure on the second boiler is only 80 lbs. no benefit will be derived from same; in fact the reverse is the case, as in all probability, priming, &c., will be caused. It is much about the same with the dynamo, if we cut the second one in at say 80 volts instead of 110. It means a difference of 30 volts, and this difference runs the dynamo and engine instead of same assisting generator No. 1. The effect on the first machine is simply that it overloads it, the lights probably go down in brilliancy, and if it is a big overload and the attendant slow in rectifying the matter, the armature on dynamo No. 1 may be burned out. The ammeters will register the same as if the machine was generating current instead of simply absorbing the power generated by the other machine, to the extent of the motor load, as it really does. The direction of rotation remains the same; the brush leads have not been altered in any way. The current is going round the fields in the same direction as it did when running as a dynamo. I will draw a figure to illustrate this. Fig. 2 shows the direction of the current from the machine, and through field coils when running as a generator, and Fig. 3 shows the direction of the currents in the same machine when running as a motor. You will observe, the current goes through the field coils in the same direction in each, although the current through the armature is going in the opposite direction. Fig. 4 shows the current through the armature apparently going in the same direction as in Fig. 2, but as same is a motor, and what is + on the one is really – on the other, although the arrows point in the same direction. You will observe that the shunt wires are crossed. By reversing the direction of rotation the polarity of the wires is also reversed, but the polarity of the field remains the same owing to the simple fact that the current is going through the coils in the same direction by the crossing of the shunt.

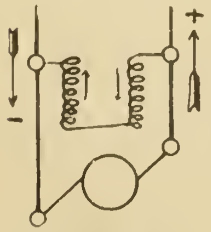

Fig 2

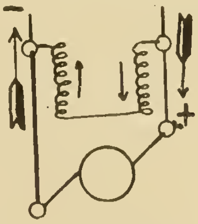

Fig 3

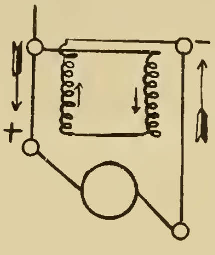

Fig 4

The electromotive force is proportional to the number of lines of force cut per second, and is therefore proportional to the intensity of the magnetic field and to the length and velocity of the moving conductor. The more powerful the magnetic field, the stronger will be the current generated. Looking at it from another standpoint—say a steam engineer's—the more steam admitted into the cylinder the more power derived from the engine; the faster the engine runs, still more the power. In all or nearly all generators the strength of the current can be altered at pleasure—some by altering the speed of the engine, others by moving the pole pieces to and from the armature, but I dare say the most common method is by changing the resistance of the field circuit and allowing a greater or a less amount of current to flow through the coils; to produce a greater current the resistance being cut out, and the opposite is done for a less current. By referring to Fig. 5 the arrangement is seen very clearly. When the current to the fields is going through all the coils marked 1-7, part of it is lost in overcoming the resistance, and by gradually cutting out any or all of the coils any combination can be obtained to the extent of rheostat.

When the contact piece is as shown by the full line, the current is going through all the coils, and if same were turned to the position as indicated by the dotted line, none of the current would pass through the resistance coils at all; there would be no obstruction, as it were, offered to the flow of current through the field coils except the resistance of the coils themselves. The dynamo at this point is doing all the work it can do provided same is running at the proper speed. If, however, more current than this is required, well, the only alternative is to increase the speed of your machine. This can be done in many ways, and I presume all engineers here to-night are conversant with them.

The rheostat or resistance box could be compared to a steam or water valve. If we wished to send a small quantity of steam or water through a set of coils, we introduce a resistance, or obstruction, as it were; this obstruction is in the form of a valve. By regulating the valve any combination of quantities can be obtained, from wide open to almost shut. If, however, we want to get more steam or water through than we can with valve wide open, in ordinary running, we have simply to increase the pressure or head, as the case may be.

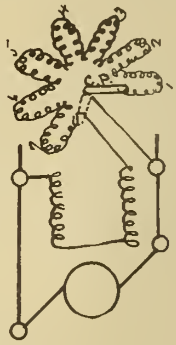

Fig 5.

When the flow of current is steady, it is immaterial what kind of magnets are used to procure the requisite magnetic field—whether permanent steel or electro magnets, self-excited or otherwise. The current as generated by the machine may be utilized to excite the magnetism of the fields by being caused wholly or partially to flow around the field coils. Let us look for a moment at the most common methods of exciting same :—

1st. With permanent steel magnets, as the ordinary magnet machine used in telephone work, fig. 6.

2nd. Separately excited machine, i. e., machines with fields excited from some external source otherwise than from the machine itself. Fig. 7.

3rd. Separate coil machines. The armature in this case is wound with two distinct windings—one for the external circuit and the other for exciting the fields. It is practically a double machine.

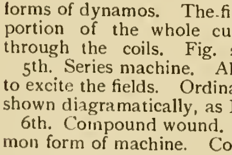

Fig 6

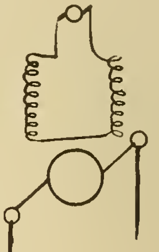

Fig 7.

4th. Shunt wound. This is one of the most common forms of dynamos. The fields are excited by a small portion of the whole current generated being let through the coils. Fig. 2 represents a shunt wound machine.

5th. Series machine. All the current generated by the armature is used to excite the fields. Ordinary arc machines are series wound, and would be shown diagramatically, as Fig. 8.

6th. Compound wound. This is another very common form of machine. Compound wound means, of course, two windings, same as a compound engine means an engine with two cylinders.

Let us now consider the three latter, viz., shunt, series, and compound wound dynamos.

For incandescent lighting, continuous currents, the shunt and compound wound machines are generally used. There are, however, several series wound machines in use for the same purpose, generally street lighting, but we will not consider them here to-night. In a shunt wound machine the E. M. F. diminishes when the resistance of the external circuit is reduced, that is to say, supposing the engine, etc., to be running at precisely the same speed and more light turned on, the pressure at the dynamo terminals, and consequently at the mains, is reduced. To rectify this, and bring same to its normal pressure, we have got to supply more current to charge the fields; this is simply done by cutting out the resistance as shown in our preceding diagram, fig. 5. As we said before, the pressure diminishes as the resistance of the external circuit is reduced. It may occur to some that turning on more lights increases the resistance; such is not the case, however, as the more lamps turned on the greater is the number of paths for the current to go through. If the resistance of one lamp is 200 ohms, the resistance of a number of lamps in multiple is therefore 200 ÷ the number of lamps. If a curve were drawn showing the fall in pressure as the resistance diminished, it would be something like Fig. 9, until same (the E M. F.) is increased by the extra current going through field coils.

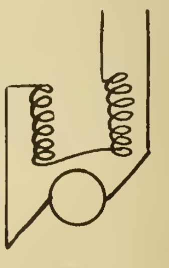

Fig 8

In a series wound machine the pressure increases when the resistance of the external circuit is decreased—just the opposite effect of the shunts. If same were drawn or plotted out, it would be something like the dotted line shown on Fig. 9. On examining the two curves you will no doubt observe that one is almost directly opposite of the other, and it may occur to some of you that by combining the two windings a different result would be obtained. This is exactly what is done in compound wound machines. The aim in compound winding is to have a constant potential at the lamps or brushes, as the case may be, regardless of the load. Suppose we have a cubic foot of steam at say 100 lbs., and another at 50 lbs., and we mix same together—we get two cubic feet at about 75 lbs. pressure. Now, by looking at these curves you will observe that one starts from 100 and descends to 0, the other starts from 0 and ascends to 100, so by combining the two an average of 50 volts is obtained. Many machines, however, are overcompensated, that is to say, they are wound with a little extra series winding so that the pressure rises slightly as the load increases. This is a very desirable thing in many cases, as it compensates for any losses that may exist in the wiring.

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* Paper read before the Canadian Marine Engineers' Association.

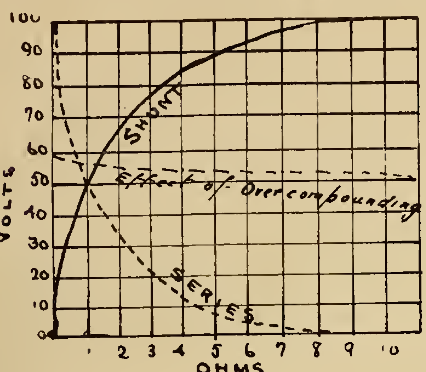

FIG 9

You will observe sometimes stamped on machine: "Wound for 10% loss." What does that mean? It means simply that if we had 100 volt lamps on our system, and running this dynamo to full load, the pressure at the terminals would be about 111 volts. This increase is done automatically by the effect of the extra series winding. Should only half the number of lights be burning, the loss would only be the half of 10% = 5, consequently our machine would be running at about 105 volts, although the pressure at the lamps themselves is only 100 volts. If we had a steam plant arranged in this manner, it would be something like this: We have, say, 10 engines, and the initial pressure at same to give the correct power must be 100 lbs. There is a loss of 10 lbs. between the boiler and the engines owing to the piping being too small, not properly covered, etc., when running at full load, and about 5 lbs. when running five engines. It therefore stands to reason that the pressure at the boiler has to be 111 and 105 lbs. respectively, so that the required initial pressure may be had at the engines. The raising of the steam pressure is done, of course, by the fireman, who answers the same purpose to the steam plant as the extra series winding does to the dynamo. This, I think, explains very clearly the compound winding and the extra compounding for certain percentages of losses in the external circuit.

We will now come to the second part of our lecture. In it we shall treat upon the practical working of the dynamos, and see their behavior, the troubles that arise, and how to get over them.

The troubles that generally affect the running of a dynamo may be briefly summarized as follows: Sparking at brushes; ring of fire around commutator; burning out of armature coils; grounded armature and fields; short-circuiting of external circuit.

Sparking at the brushes may be caused in a multitude of ways, viz., brushes not set diametrically opposite, not set at the neutral point, not bearing properly on commutator, not having sufficient pressure, brushes filled with dirt and oil, commutator dirty, high or low bars in commutator, poor connection between the armature coils and commutator bars, section short-circuited either in armature coils or in commutator, commutator worn in ridges, out of truth, dynamos overloaded and armature damp—will all cause sparking at the brushes. Too much care can never be bestowed on the filing and proper adjusting of the brushes. One can almost tell at a glance what sort of a man is in charge of a dynamo by seeing the condition of the brushes and commutator. If he is a careful attendant everything will be kept in the best possible condition. Brushes should be set with the least possible pressure; not, however, too loose, so that they will spring off. Should a high or a low bar make itself manifest during a run, the tension on the brushes has to be increased until such time as the defect is remedied. To rectify a high bar, one method is to drive same down flush with the rest of the commutator and screw up the collar; the other is to file same down flush. If the bar is low, screw up the collar firmly and turn the rest of the commutator down to suit.

A loose connection, or a poor joint between armature coil and commutator, will make itself apparent at every revolution. It will show at the particular bar having the loose connection. A "flat" will be caused thereby on the commutator and it would appear that this segment was made of softer material than the rest. The whole trouble originates, however, from the bad connection. This should be rectified with as little delay as possible, for time does not improve matters any. The remedy for this is to unsolder the joint and scrape the wires thoroughly clean and see that same are properly tinned and soldered up in good style. This appears to some to be a very easy job, but if great care is not taken the matter will be made worse instead of better. Some think that if the joint looks all right from the outside then everything is all right, but sometimes you will run across a joint where to all appearances everything is perfect, and it sometimes seems a pity to disturb same, but when you unsolder it a different state of affairs is seen. The wires are not even cleaned; solder has never been near them. Have all wires thoroughly cleaned before you attempt to solder them. This fault, viz., poor connection, scarcely shows up until after a machine has run a short time.

When a section is short-circuited or burnt out, unless the attendant is thoroughly familiar with the winding, it will perhaps be better for him not to attempt to repair same. One way out of the difficulty, if a spare armature is not at hand and the lights must be kept going, is simply to cut out the injured coil altogether. Disconnect same from the commutator and the two adjacent bars to which the coil was connected and join same together with a piece of wire not smaller than the rest of the winding. You are now running the armature minus that coil or coils. It will run this way for a long time and give excellent satisfaction. It should be repaired, however, the very first opportunity.

If the armature is damp the dynamo should not be started up until same is rectified. It is very seldom that an armature becomes damp if it is used every now and again. It is more likely to be this way when starting up the machine for the first time, owing probably to same being not sufficiently packed up or taken care of in transit. The remedy is simply to bake same above the boilers or beside a stove.

Sometimes a ring of fire is seen around the commutator. This is not a very serious matter and can easily be got rid of. It is caused by particles of copper getting in between the commutator bars, thereby making a local short circuit from bar to bar across the insulation. This is most likely to occur when the commutator has been filed or turned up, and to remedy this examine each segment carefully and remove all particles of copper connecting any of the bars together.

Burning out of fields very seldom occurs, and we need not lose much time on this. It is an easy matter to test which field is burned out by an ordinary magneto bell.

Armature grounded. This is quite a common trouble, and one liable to give serious results if not attended to. If only one coil is grounded no great harm can result, but should another one get grounded, it is simply a question of a few seconds before same is useless. Again, suppose one coil is grounded and the machine not properly insulated from "earth," a short circuit is formed through the armature to ground and the armature is burned out as before. It is a very easy matter to test for a grounded armature or a grounded machine, and no excuse should be taken for this state of affairs, especially the machine being grounded.

Reversal of polarity is a trouble that no one will experience with generators running in multiple It is only when run in series that this occurs. I need not therefore take up your time with this, but should anyone desire to know the easiest and quickest method of recharging the fields I will be happy to inform him at the close of the paper.

"Short circuit" is a word I think familiar to every one. The technical meaning, however, may not be so familiar. It is "a shunt of low resistance introduced into a circuit either accidentally or otherwise." This is without doubt the most frequent trouble in running dynamos. They range from what is called a short-circuited lamp, taking ⅙th of a H. P. to burn out, to the "ground," taking several thousand H. P. to get rid.

How does a short circuit affect a dynamo or dynamos in the manner they do? Suppose we have got a small engine, say 50 H. P., and a 500 light dynamo with the full complement of lamps installed. The current required for 500 lamps is about 220 amperes. You can arrive at this result in the following manner: The resistance of one lamp is 220 ohms; R. of 500 lamps = 220 ÷ 500 = say .5 ohms. The current required according to Ohm's law, which is $C = \frac{E}{R}$ would therefore be $C = \frac{110 \text{ volts}}{.5 \text{ ohms}} = 220$ amperes. $\frac{220 \times 110}{746} = 33$ E. H. P. + 20% for losses in armature and field coils, and 20% for friction, etc., making an indicated H. P. of about 45. We will not take into consideration the resistance of the wiring, as same is supposed to be very little, but the extra allowance on the resistance of the lamps will make up for this. It is accurate as far as our needs are at present. A piece of wire or anything metallic having little resistance comes in contact with the two conductors. We will say the resistance of same is .25 ohms. This shunt or wire will carry, if same has good contact, twice as much current as we have already on our machine, viz., 440 amperes, for by applying the same rule as before, viz., $\frac{110}{.25} = 440$ = about 70 H. P. This amount of current would flow if the engine and dynamos were capable of transmitting same, and the safety appliances at that time were, as usual, out of order. We said our engine was 50 H. P., and we were running same up to 45 H. P.; another load of 70 H. P. has come suddenly on, or an overload on dynamo and engine of about 130%. What is the result? Is it to be wondered at that armatures give out or engines are disabled?

There are or should be in every installation safety devices for breaking the circuit when a load of more than the safe carrying capacity of the wires comes on. They should be carefully adjusted to the requirements of the system, so as to come into play when the load reaches a certain percentage above the normal. Sometimes one of these safety devices, or cut-outs, persists in burning out, showing clearly that something is wrong. Instead of tracing out the trouble, the attendant having too much to do, or "hasn't time"—that never failing excuse—puts in a larger fuse, or piece of copper wire, so that same *will not* burn out. This is something similar to tying down a safety valve on a boiler so that same will not blow off when the correct pressure is reached. The results we are all familiar with, especially when they bring the factor of safety to a minus quantity. Having now put in a bigger fuse, one larger than the carrying capacity of the conductors, and as we have indicated, there is a short circuit on the line by the safety fuses giving out, the switch is now closed. What is the result?—a fine display of fireworks, and in all probability an armature gone!

In central stations where there are thousands of horse power at command, it is common practice to burn out grounds or short circuits. A ground is without doubt the worst kind of a short circuit, the earth in this case being the shunt, and is the worst trouble that can come over an electric light plant. Grounds always develop when running at a light load. When one does come on no time has to be lost in getting rid of same. It is simply a case of cutting in engine after engine, dynamo after dynamo, until you have got sufficient power to burn it out.

It is only when trouble arises in an electric plant that the necessary qualifications of those in charge are made manifest. One must be able to grasp the situation at a glance, know exactly what the trouble is and rectify same with the least possible delay. Presence of mind, calm and correct judgment, quick action, all combined, are all necessary in cases of emergency.

Short circuits will scarcely burn out a shunt wound dynamo, for as we saw in the former part of the paper, when the resistance of the external circuit is diminished the E. M. F. goes down. Now, when a short circuit or ground comes on it is neither more nor less than a big load, and if the machine is not strong enough to burn out same, the E. M. F. will gradually diminish until there is no pressure whatever to do any harm. With series and compound wound machines the results are different. We also saw before that the E. M. F. increased when the resistance of the circuit diminished, that is, when the load is increased. In the compound wound, the shunt winding simply becomes inoperative, and the series winding increases the pressure, etc., to such an extent that the dynamo simply burns itself up in the attempt to meet the demands made upon it. As nearly all dynamos in steam boats, street railway power houses, and all central stations, excepting probably Edison, are compound wound, it is not to be wondered at the large number of accidents which occur to engines and dynamos when subjected to such enormous overloads.

We will suppose that we have got in our possession a street railway power plant of say five 500 H. P. engines, and generators, etc., to suit. Devices known as circuit breakers are put in each circuit leading from the generators to the feeders. These circuit breakers answer the same purpose to the street railway plant as the safety fuses do to the lighting plants. It is very often these safety appliances do not operate when they are required to, or they are so arranged that they will *not* operate—generally the latter—and in many cases do serious damage. A heavy ground comes on our plant, the circuit breakers respond almost immediately to the overload on four of the generators, but the fifth one fails to act. What is the result? This engine and dynamo has not only got the "ground" to contend with, but has also got the load of the other four generators, making probably a load of about 3000 H. P. on this engine and dynamo, if same were capable of transmitting same. Surely quite enough to wreck any 500 H. P. engine and generator?

Before finishing up, I wish to draw your attention to one other item, viz., cleanliness. We are told in the good book that cleanliness is next to godliness. I think this applies more directly to electrical apparatus than any other machinery in existence. I have not come across in the aforesaid book that any electrical plants were in existence when the above phrase was written, but I think there must have been. Keep everything in order; keep everything in the cleanest possible state; have all contacts bright and switches in good order. All switches should carry their rated load with little or no heating up. Where there is heat in conductors or switches there is a loss. Overcome all these losses. If everything is kept scrupulously clean, there will be very little trouble experienced in running isolated plants. Some machines on examination would reveal the fact that same were for making copper dust instead of generating current; have no copper dust lying around dynamos, as this is one of the first causes of trouble.

In conclusion, I wish to thank you for the very patient manner in which you have all listened to me, and I hope that some will be benefitted thereby.

ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.

By Nikola Tesla.

(Concluded.)

In regard to the incandescence of a refractory button (or filament) in an exhausted receiver, which has been one of the subjects of this investigation, the chief experiences, which may serve as a guide in constructing such bulbs, may be summed up as follows: 1. The button should be as small as possible, spherical, of a smooth or polished surface and of refractory material, which withstands evaporation best. 2. The support of the button should be very thin and screened by an aluminum and mica sheet, as I have described on another occasion. 3. The exhaustion of the bulb should be as high as possible. 4. The frequency of the currents should be as high as practicable. 5. The currents should be of a harmonic rise and fall, without sudden interruptions. 6. The heat should be confined to the button by enclosing the same in a small bulb or otherwise. 7. The space between the walls of the small bulb and the outer globe should be highly exhausted.

Most of the considerations which apply to the incandescence of a solid just considered may likewise be applied to phosphorescence. Indeed, in an exhausted vessel the phosphorescence is, as a rule, primarily excited by the powerful beating of the electrode stream of atoms against the phosphorescent body. Even in many cases, where there is no evidence of such a bombardment, I think that phosphorescence is excited by violent impacts of atoms, which are not necessarily thrown off from the electrode, but are acted upon from the same inductively through the medium or through chains of other atoms. That mechanical shocks play an important part in exciting phosphorescence in a bulb may be seen from the following experiment. If a bulb, constructed as that illustrated in Fig. 10, be taken and exhausted with the greatest care so that the discharge cannot pass, the filament f acts by electrostatic induction upon the tube t, and the latter is set in vibration. If the tube o be rather wide, about an inch or so, the filament may be so powerfully vibrated that whenever it hits the glass tube it excites phosphorescence. But the phosphorescence ceases when the filament comes to rest. The vibration can be arrested and again started by varying the frequency of the currents. Namely, the filament has its own period of vibration, and if the frequency of the currents is such that there is resonance, it is set easily vibrating, though the potential of the currents be small. I have often observed that the filament in the bulb is destroyed by such mechanical resonance. The filament vibrates as a rule so rapidly that it cannot be seen, and the experimenter may at first be mystified. When such an experiment as the one described is carefully performed, the potential of the currents need be extremely small, and for this reason I infer that the phosphorescence is then due to the mechanical shock of the filament against the glass, just as it is produced by striking a loaf of sugar with a knife. The mechanical shock produced by the projected atoms is easily noted when a bulb containing a button is grasped in the hand and the current turned on suddenly. I believe that a bulb could be shattered by observing the conditions of resonance.

In the experiment before cited it is, of course, open to say that the glass tube upon coming in contact with the filament retains a charge of a certain sign upon the point of contact. If now the filament again touches the glass at the same point while it is oppositely charged, the charges equalize under evolution of light. But nothing of importance would be gained by such an explanation. It is unquestionable that the initial charges given to the atoms or to the glass play some part in exciting phosphorescence. So, for instance, if a phosphorescent bulb be first excited by a high frequency coil by connecting it to one of the terminals of the latter and the degree of luminosity noted, and then the bulb be highly charged from a Holtz machine by attaching it preferably to the positive terminal of the machine, it is found that when the bulb is again connected to the terminal of the high frequency coil, the phosphorescence is far more intense. On another occasion I have considered the possibility of some phosphorescent phenomena in bulbs being produced by the incandescence of an infinitesimal layer on the surface of the phosphorescent body. Certainly, the impacts of the atoms are powerful enough to produce intense incandescence by the collisions, since they bring quickly to a high temperature a body of considerable bulk. If any such effect exists, then the best appliance for producing phosphorescence in a bulb, which we know so far, is a disruptive discharge coil giving an enormous potential with but few fundamental discharges, say 25-30 per second, just enough, to produce a continuous impression upon the eye. It is a fact that such a coil excites phosphorescence under most any condition and at all degrees of exhaustion, and I have observed effects which appear to be due to phosphorescence even at ordinary pressures of the atmosphere, when the potentials are extremely high. But if phosphorescent light is produced by the equalization of charges of electrified atoms (whatever this may mean ultimately), then the higher the frequency of the impulses or alternate electrifications, the more economical will be the light production. It is a long known and noteworthy fact that all the phosphorescent bodies are poor conductors of electricity and heat, and that all bodies cease to emit phosphorescent light when they are brought to a certain temperature. Conductors on the contrary do not possess this quality. There are but few exceptions to the rule. Carbon is one of them. Becquerel noted that carbon phosphorescences at a certain elevated temperature preceding the dark red. This phenomenon may be easily observed in bulbs provided with a rather large carbon electrode (says a sphere of six millimetres diameter). If the current is turned on after a few seconds, a snow white flim covers the electrode, just before it gets dark red. Similar effects are noted with other conducting bodies, but many scientific men will probably not attribute them to true phosphorescence. Whether true incandescence has anything to do with phosphorescence excited by atomic impact or mechanical shocks still remains to be decided, but it is a fact that all conditions, which tend to localize and increase the heating effect at the point of impact, are almost invariably the most favorable for the production of phosphorescence. So, if the electrode be very small, which is equivalent to saying in general, that the electric density is great, if the potential be high, and if the gas be highly rarefied, all of which things imply high speed of the projected atoms, or matter, and consequently violent impacts—the phosphorescence is very intense. If a bulb provided with a large and small electrode be attached to the terminal of an induction coil, the small electrode excites phosphorescence while the large one may not do so, because of the smaller electric density and hence smaller speed of the atoms. A bulb provided with a large electrode may be grasped with the hand while the electrode is connected to the terminal of the coil and it may not phosphoresc; but if instead of grasping the bulb with the hand, the same be touched with a pointed wire, the phosphorescence at once spreads through the bulb, because of the great density at the point of contact. With low frequencies it seems that the gases of great atomic weight excite more intense phosphorescence than those of smaller weight, as for instance, hydrogen. With high frequencies the observations are not sufficiently reliable to draw a conclusion. Oxygen, as is well known, produces exceptionally strong effects, which may be in part due to chemical action. A bulb with hydrogen residue seems to be most easily excited. Electrodes which are most easily deteriorated produce more intense phosphorescence in bulbs, but the condition is not permanent because of the impairing of the vacuum and the deposition of the electrode matter upon the phosphorescent surfaces. Some liquids as oils, for instance, produce magnificent effects of phosphorescence (or fluorescence?), but they last only a few seconds. So if a bulb have a trace of oil on the walls and the current is turned on, the phosphorescence only persists for a few moments until the oil is carried away. Of all bodies so far tried, sulphide of zinc seems to be the most suspectible to phosphorescence. Some samples obtained through the kindness of Prof. Henry in Paris, were employed in many of these bulbs. One of the defects of this sulphide is, that it loses its quality of emitting light when brought to a temperature which is by no means high. It can therefore, be used only for feeble intensities, An observation which might deserve notice is, that when violently bombarded from an aluminium electrode it assumes a black color, but singularly enough, it returns to the original condition when it cools down.

The most important fact arrived at in pursuing investigations in this direction is, that in all cases it is necessary, in order to excite phosphorescence with a minimum amount of energy, to observe certain conditions. Namely, there is always no matter what the frequency of the currents, degree of exhaustion and character of the bodies in the bulb, a certain potential (assuming the bulb excited from one terminal) or potential difference (assuming the bulb to be excited with both terminals) which produces the most economical result. If the potential be increased, considerable energy may be wasted without producing any more light, and if it be diminished, then again the light production is not as economical. The exact condition under which the best result is obtained seems to depend on many things of a different nature, and it is to be yet investigated by other experimenters, but it will certainly have to be observed when such phosphorescent bulbs are operated, if the best results are to be attained.

Coming now to the most interesting of these phenomena, the incandescence or phosphorescence of gases, at low pressures or at the ordinary pressure of the atmosphere, we must seek the explanation of these phenomena in the same primary causes, that is, in shocks or impacts of the atoms. Just as molecules or atoms beating upon a solid body excite phosphorescence in the same or render it incandescent, so when colliding among themselves they produce similar phenomena. But that is very insufficient explanation and concerns only the crude mechanism. Light is produced by vibrations which go on at a rate almost inconceivable. If we compute, from the energy contained in the form of known radiations in a definite space the force which is necessary to set up such rapid vibrations, we find, that though the density of the ether be incomparably smaller than that of any body we know, even hydrogen, the force is something surpassing comprehension. What is this force, which in mechanical measure may amount to thousands of tons per square inch? It is electrostatic force in light of modern views. It is impossible to conceive how a body of measurable dimensions could be charged to so high a potential that the force would be sufficient to produce these vibrations. Long before any such charge could be imparted to the body it would be shattered into atoms. The sun emits light and heat, and so does an ordinary flame or incandescent filament, but in either of these can the force be accounted for if it be assumed that it is associated with the body as a whole. Only in one way may we account for it, namely, by identifying it with the atom. An atom is so small, that if it be charged by coming in contact with an electrified body and the charge be assumed to follow the same law as in the case of bodies of measureable dimensions, it must retain a quantity of electricity which is fully capable of accounting for these forces and tremendous rates of vibration. But the atom behaves singularly in this respect, it always takes the same "charge."

It is very likely that reasonant vibration plays a most important part in all manifestations of energy in nature. Throughout space all matter is vibrating, and all rates of vibration are represented, from the lowest musical note to the highest pitch of the chemical rays, hence an atom, or complex of atoms, no matter what its period, must find a vibration with which it is in resonance. When we consider the enormous rapidity of light vibrations, we realize the impossibility of producing such vibrations directly with any apparatus of measurable dimensions, and are driven to the only possible means of attaining the object of setting up waves of light by electrical means and economically, that is. to effect the molecules or atoms of a gas, to cause them to collide and vibrate. We then must ask ourselves—How can free molecules or atoms be affected?

It is a fact that they can be affected by electrostatic force, as is apparent in many of these experiments. By varying the electrostatic force we can agitate the atoms, and cause them to collide under evolution of heat and light. It is not demonstrated beyond doubt that we can affect them otherwise. If a luminous discharge is produced in a closed exhausted tube, do the atoms arrange themselves in obedience to any other but to electrostatic force acting in straight lines from atom to atom? Only recently I investigated the mutual action between two circuits with extreme rates of vibration. When a battery of a few jars (c c c c, Fig. 32) is discharged through a primary P of low resistance (the connections being as illustrated in Figs, 19a. 19b and 19c), and the frequency of vibration be many million there are great differences of potential between points on the primary not more than a few inches apart. These differences may be 10,000 volts per inch, if not more, taking the maximum value of the E. M. F. The secondary s is therefore acted upon by electrostatic induction, which is in such extreme cases of much greater importance than the electrodynamic. To such sudden impulses the primary as well as the secondary are poor conductors, and therefore great differences of potential may be produced by electrostatic induction between adjacent points on the secondary. Then sparks may jump between the wires and streamers become visible in the dark if the light of the discharge through the spark gap d d be carefully excluded. If now we substitute a closed vacuum tube for the metallic secondary s, the differences of potential produced in the tube by electrostatic induction from the primary are fully sufficient to excite portions of it; but as the points of certain differences of potential on the primary are not fixed, but are generally constantly changing in position, a luminous band is produced in the tube, apparently not touching the glass, as it should, if the points of maximum and minimum differences of potential were fixed on the primary. I do not exclude the possibility of such a tube being excited only by electrodynamic induction, for very able physicists hold this view; but in my opinion, there is as yet no positive proof given that atoms of a gas in a closed tube may arrange themselves in chains under the action of an electromotive impulse produced by electro-dynamic induction in the tube. I have been unable so far to produce striae in a tube, however long, and at whatever degree of exhaustion, that is striae at right angles to the supposed direction of the discharge or the axis of the tube, but I have distinctly observed in a large bulb, in which a wide luminous band was produced by passing a discharge of a battery through a wire surrounding the bulb, a circle of feeble luminosity between two luminous bands, one of which was more intense than the other. Furthermore, with my present experience I do not think that such a gas discharge in a closed tube can vibrate, that is vibrate as a whole. I am convinced that no discharge through a gas can vibrate. The atoms of a gas behave very curiously in respect to sudden electric impulses. The gas does not seem to possess any appreciable inertia to such impulses, for it is a fact, that the higher the frequency of the impulses, with the greater freedom does the discharge pass through the gas. If the gas possesses no inertia then it cannot vibrate, for some inertia is necessary for the free vibration. I conclude from this that if a lightning discharge occurs between two clouds, there can be no oscillation, such as would be expected, considering the capacity of the clouds. But if the lightning discharge strike the earth, there is always vibration—in the earth, but not in the cloud. In a gas discharge each atom vibrates at its own rate, but there is no vibration of the conducting gaseous mass as a whole. This is an important consideration in the great problem of producing light economically, for it teaches us that to reach this result we must use impulses of very high frequency and necessarily also of high potential. It is a fact that oxygen produces a more intense light in a tube. Is it because oxygen atoms possess some inertia and the vibration does not die out instantly? But then nitrogen should be as good, and chlorine and vapors of many other bodies much better than oxygen, unless the magnetic properties of the latter enter prominently into play. Or, is the process in the tube of an electrolytic nature? Many observations certainly speak for it, the most important being, that matter is always carried away from the electrodes and the vacuum in a bulb cannot be permanently maintained. If such process takes places in reality, then again must we take refuge to high frequencies, for with such, electrolytic action should be reduced to a minimum, if not rendered entirely impossible. It is an undeniable fact that with very high frequencies, provided the impulses be of a harmonic nature, like those obtained from an alternator, there is less deterioration and the vacua are more permanent. With disruptive discharge coils there are sudden rises of potential and the vacua are more quickly impaired, for the electrodes are deteriorated in a very short time. It was observed in some large tubes, which were provided with heavy carbon blocks B B^1, connected to platinum wires w w^1 (as illustrated in Fig. 23), and which were employed in experiments with the disruptive discharge instead of the ordinary air gap, that the carbon particles under the action of the powerful magnetic field in which the tube was placed, were deposited in regular fine lines in the middle of the tube as illustrated. These lines were attributed to the deflection or distortion of the discharge by the magnetic field, but why the deposit occurred principally where the field was most intense did not appear quite clear. A fact of interest, likewise noted, was that the presence of a strong magnetic field increases the deterioration of the electrodes, probably by reason of the rapid interruptions it produces, whereby there is actually a higher E. M. F. maintained between the electrodes.

Much would remain to be said about the luminous effects produced in gases at low or ordinary pressures. With the present experiences before us we cannot say that the essential nature of these charming phenomena is sufficiently known. But investigations in this direction are being pushed with exceptional ardor. Every line of scientific pursuit has its fascinations, but electrical investigation appears to possess a peculiar attraction, for there is no experiment or observation of any kind in the domain of this wonderful science which would not forcibly appeal to us. Yet to me it seems, that of all the many marvelous things we observe, a vacuum tube, excited by an electric impulse from a distant source, bursting forth out of the darkness and illuminating the room with its beautiful light, is as lovely a phenomenon as can greet our eyes. More interesting still it appears when reducing the fundamental discharges across the gap to a very small number and waving the tube about we produce all kinds of designs in luminous lines. So, by way of amusement, I take a straight long tube, or a square one, or a square attached to a straight tube, and by whirling them about in my hand, I imitate the spokes of a wheel, a Gramme winding, a drum winding, an alternate current motor winding, etc. (Fig. 34). Viewed from a distance the effect is weak and much of its beauty is lost, but being near or holding the tube in the hand, one cannot resist its charm.

In presenting these insignificant results I have not attempted to arrange and co-ordinate them, as would be proper in a strictly scientific investigation, in which very succeeding result should be a logical sequence of the preceeding, so that it might be guessed in advance by the careful reader or attentive listener. I have preferred to concentrate my energies chiefly upon advancing novel facts or ideas which might serve as suggestions to others, and this may serve as an excuse for the lack of harmony. The explanations of the phenomena have been given in good faith and in the spirit of a student prepared to find that they admit of a better interpretation. There can be no great harm in a student taking an erroneous view, but when great minds err, the world must dearly pay for their mistakes.

PUALICATIONS.

The February Arena is another mammoth number of the great progressive Review. It contains 164 pages and filled with able papers, covering a wide range of topics of special interest to wide awake thinkers and earnest reformers.

The Ontario Legislature is asked to grant incorporation to the Portlock and Desert Lake Iron Mining and Railway Company, which proposes to build an electric or steam and electric railway from Portlock, in Algoma, northward to a junction with the Northern Pacific Railway. Mr. James Stobie, a well-known miner, is one of the promoters.

ELECTRIC RAILWAY DEPARTMENT.

An increase of $16,959, is shown in the earnings of the Montreal Street Railway Company for the last quarter, as compared with the same period in 1893.

The village Council of Portsmouth, Ont., has granted a franchise for forty years to the Kingston, Portsmouth & Cataraqui Company, for the construction of an electric railway on the streets of the said village.

Toronto Lodge of the International Association of Machinists has adopted a resolution urging the City Council to compel the Toronto Railway Company to comply with the clauses of its agreement with the city which provide that all plant required for the use of the railway shall be as far as possible manufactured in the city of Toronto.

A special committee of the County Council of York has drafted an agreement between the county and the Metropolitan Street Railway Company, defining the conditions under which the railway company may extend its lines to Richmond Hill and Lake Simcoe. The agreement is subject to the ratification of the council at its next meeting in June.

The annual general meeting of the Montreal Park and Island Railway Company was held in Montreal a fortnight ago, at which an outline of the operations of the coming summer was presented. Only one change in the directorate was made, it being the appointment of Mr. J. S. Bousquet in the place of Mr. Morris Perrault, whe resigned some three months ago.

The Hamilton, Beamsville and Grimsby Electric Railway Company's new power station at Stoney Creek, the construction of which is about to be commenced will be built of brick and stone and roofed with asphalt. The size of engine and dynamo room will be 40 by 60 feet and of boiler room 40 by 30 feet, with a chimney stack 115 feet high. The plant will include two generators and two boilers.

Information has been received at Winnipeg, that the Privy Council in England has given a verdict in favor of the Electric Railway Company on all points involved in its dispute with the Winnipeg Street Railway, which claimed to have been granted a monopoly of the streets for railway purposes. As the result of this decision, it is said the electric railway company will at once proceed to extend its lines.

At the request of the City Council, the City Engineer of Toronto has handed in a report on the cost of a single track electric railway from Hanlan's to Ward's on Toronto Island. It is estimated that to construct a single track on the west and south shores of the island, and equip the same with four motor cars and four trailers, would cost $50,000, and the cost of operation would be $50 per day.

The Toronto Railway Company has presented a counter petition to the Ontario Legislature asking that the company be not compelled to provide shelter for the motormen as petitioned for by the City of Toronto, on the ground that such provision is not contained in its agreement with the city, and that owing to the use of trailers it would be impracticable to work the cars with safety if vestibules were adopted.

During the past month the Board of Directors of the Galt and Preston Street Railway awarded the contract for the electrical construction of their road to Messrs. Ahearn & Soper, of Ottawa, The contract for supplying the engines and boilers for the power house at Preston has been given to Messrs. Goldie & McCulloch, of Galt. Five cars will be used on the road and will be heated by electricity during the winter months. Tenders for the erection of the power house will be awarded in a few days.

A franchise has been granted to Mr. W. R. Hitchcock to build and operate an electric railway at Cornwall, Ont. The franchise provides for the construction of the road, to carry both passengers and freight, to the canal, and the entire length of Second street, with spur lines to the cotton and paper mills, a total distance of about four miles. It is the intention to utilize the water power at Sheik's Island Dam. Mr. Hitchcock is now in the United States for the purpose of organizing his company, the intention being to commence the construction of the road in the spring, The Westinghouse system will be employed. The town council have agreed to exempt from taxation for a period of ten years, the plant and income of the company.

The annual report of the Niagara Falls Park and River Railway Company has been presented to the Legislature. It sets forth that after the road had gone into operation, the impossibility of handling the traffic with a single track became apparent, and the directors decided to issue $300,000 of additional stock for the purpose of double tracking the line. $200,000 of this stock has been allotted, and all the grading for the second track done, with the exception of four miles. The company have arranged for a first-class steamboat connection between Buffalo and Chippewa, and are anticipating that a large business will come through this Buffalo connection. The receipts of the road from the time of its going into operation, on the first of July last, to the close of the season, was $58,064.08, and the expenses, $39,135.06.

Some time ago, the council of the Township of York passed a by-law granting a bonus of $20,000 to the Toronto and Richmond Hill Street Railway Company, on condition that certain construction work was to be completed by the 7th day of March of the present year. Shortly afterwards some of the property owners along the route took action in the courts to prevent the construction of the road, and the legal proceedings thus taken interfered with the floating of the bonds of the company, and consequently prevented them from completing the amount of construction called for by the bonus by-law. At a recent meeting of the Township Council, the by-law granting the bonus, was revoked on the ground that the railway company had failed to fulfil its part of the agreement. The company thereupon presented a petition to the Legislature, setting forth that the actions which had been taken against it in the courts had made it impossible to proceed with construction and asking that the time for completing the railway be extended for two years, and that the by-laws passed by the Township Council granting the bonus, be declared valid and binding. The Legislature has acceded to the company's petition.

Engineers are often slow in adopting changes in their boiler settings, and with so many plans that are urged to their attention, and often of little value, it is perhaps wise to be cautious, but we have often wondered why they do not take more kindly to removable fire-door arches. When the arch overhead burns out it is a source of danger and considerable expense to replace the arch with a new one or to repair it. There are devices that will not burn out and must pay for themselves in time, not only by the actual saving in the expense of constantly renewing the arches, but in the renewed safety and lengthened life of the boiler.

USEFUL HINTS.

Some recent figuring on the cost of power conveyed by water shows that the greater the pressure the cheaper in proportion becomes the expense or cost. For example, water at 100 pounds pressure costs about double what water at 700 pounds pressure will, estimating in both cases by the energy or work the water will perform. This is a curious result, and an interesting problem. The water and the pressure upon it are different elements. The amount consumed for a given duty is inversely as the pressure.—*Power.*

STEEL AND IRON TUBES.—Quite an important discussion took place before the Master Mechanics' Association at its recent Saratoga meeting on the character or merits of steel and iron tubes respectively. It was announced in a report on this subject, that, in the case of a large number of steel tubes, the results, so far as wear is concerned, have been unfavorable. The following definite experiment was cited: An engine was equipped with 114 iron tubes and 113 steel tubes, Dec. 20, 1890. The iron tubes were placed on one side of the centre and the steel tubes on the other side of the centre of the boiler, the tubes being divided by a vertical line through the centre of the flue sheet. At the expiration of fifteen months the flues were all removed, the condition of the tubes being such that seventeen of the iron ones were condemned on account of pitting and corrosion, while sixty-four of the steel tubes were condemned for the same defect, the inferiority of the latter being thus largely in excess of the iron tubes.

When a pound of water is turned into steam it will occupy very much less space as the pressure increases; therefore, one cylinderful of steam at high pressure will weigh a great deal more than a cylinderful at low pressure; the amount of heat required to make a given cylinderful of steam increases with its pressure and consequently its weight; that there is more heat in a radiator full of high pressure steam than low-pressure steam, because of above fact; that the temperature of steam increases with the pressure; that the temperature at which water will boil increases with the pressure and equals the temperature of the steam formed from it; that the latent heat of steam is less as the pressure increases; that when steam leaves a cylinder it has in it an amount of latent heat according as the pressure of the steam is greater or less; that it could not leave as steam unless this latent heat was in it, as this heat must be in it or it would be water; that this latent heat can be obtained outside the engine for heating purposes when the steam is condensed to water; that in being so condensed it occupies a materially smaller space and creates a partial vacuum in the space it had previously occupied; that steam at a certain pressure has a certain sensible temperature, and is then known as saturated steam, but that this temperature can be increased by the addition of heat directly to the steam itself, when it becomes known as superheated steam.

TBADE NOTES.

Messrs. Ahearn & Soper, of Ottawa, report the following recent sales of Westinghouse apparatus: a 650 light alternating plant for Chesley, Ont., two 15 K. W. continuous current, slow speed dynamos to the Richelieu and Ontario Navigation Co., for use on their steamers; a 650 light alternating current plant to Mr. Brosseau, of the St. Hyacinthe Gas Co. A sale has also been made of a 1000 light alternator for Windsor, N. S., including the street lighting system, wire, transformers, panel switchboard and all appurtenances.

Readers will notice by our advertising columns that Mr. John Forman has secured the Canadian agency for some of the most reliable manufacturers of electric appliances in England. He intends opening out in the store No. 650 Craig street, Montreal, where he will have one of the best assorted stocks of electrical goods in Canada including the highest class of English fittings and all the latest novelties of English manufacture. His intention is to do a first-class electrical supply business and the names of the firms he represents are a sufficient guarantee that everything in stock will be of the very best quality.

The F. E. Dixon Belting Company, of Toronto, has just issued a valuable handbook of useful information relating to the use of leather belting. The book contains a large amount of valuable data which has been put in convenient form for the use of engineers and others who are called upon to make use of belting under a great variety of conditions and circumstances. This information, Mr. Dixon informs us, has been carefully collected during a period of many years, and its accuracy thoroughly inquired into and proved. In addition, the book contains flattering testimonials from a number of substantial business firms throughout Canada as to the excellent quality of the belting manufactured by this company, some of which is declared to have been in use upwards of twenty years, and is apparently good for several years more service. We notice that the company have recently established a branch house at 13 Lemoine street, Montreal.

The attention of electric lighting companies and others using arc lamps is called to the announcement in our advertising pages of the Exact Arc Lamp Company of Canada, Hamilton, Ont. This company have the exclusive right to manufacture in Canada the Exact arc lamp, the invention of Mr. Irish, the construction of which differs very materially from that of the types of lamps generally in use. These lamps are equipped with a very ingenious thermal regulator. They have no magnets or solonides, regulation being effected by the contracting of a strip of metal. As the arc becomes longer from the burning of the carbon the decreased current heats the metal less, which contracts and permits the carbon to feed down or vice versa. The regulation clutch is constructed on a differential principle, is very simple in construction and enables the lamp to furnish an absolutely steady light. The mechanism is equally applicable to direct or alternating circuits, and greatly reduces the singing when used with the latter. The new lamp is interchangeable from arc to incandescent circuits and vice versa. The Canadian manufacturers will be pleased to furnish all particulars regarding the new lamp.

The Dodge Wood Split Pulley Co., of Toronto, are recently in receipt of the following letter of endorsation from the E. B. Eddy, Co., of Hull, Que., which speaks for itself:

HULL, CANADA, 12th February, 1894.

MESSRS. DODGE WOOD SPLIT PULLEY CO., Toronto, Ont.

DEAR SIRS:—Replying to the reques contained in your letter of the 9th inst. as to how we are pleased with the rope drive system put into our mills by you, we would say that some four years ago we put in a small rope drive, about 20 H. P. A year and a half ago we put in three drives, each 500 H. P,, whereas last year we put in one 400 H. P., one 300 H. P., and one 200 H. P., all of which are giving us good satisfaction. For main drives or long distances, for transmitting of power, we think there is nothing to equal these drives. We would recommend them to any person requiring similar power.

Yours truly,

(signed) The E. B. EDDY CO.

... THE ...

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CAPITAL,
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Thomson-Houston Street Railway Generators and Motors

(Same as built by us for Niagara Falls Park & River Railway.)

Thomson-Houston Systems of Alternating Current Apparatus for Incandescent Lighting.

Edison-Systems of Low-Tension Direct Current Apparatus for Incandescent Lighting.

Electric Arc Lighting Apparatus. Electric Mining Apparatus.

Apparatus for Long Distance Transmission of Power.

WE MANUFACTURE IN CANADA EVERY DESCRIPTION OF ELECTRICAL MACHINERY AND ELECTRICAL SUPPLIES.

INSULATED WIRES

FOR ELECTRICAL USES

Our wire factory is one of the best equipped on the continent.

We manufacture every description of insulated wires and cables, and our large production enables us to offer special values.

We desire at this season to call attention to our

Standard Weatherproof Wires,
White Weatherproof Wires,
Rubber Covered Wires,
Magnet Wires,
Office and Annunciator Wires,
Flexible Incandescent Light Cords.

Our solid core Rubber Covered Wire has the best insulation resistance, best quality of rubber, and gives the most general satisfaction to users.

TRANSFORMERS

To no other class of apparatus can the axiom that "the best is the cheapest" be more truly applied than to electrical machinery and appliances. To transformers does this especially apply. It will pay you to buy the best in the market, and we now offer you the very best at such a reduced price that the essentials of quality and efficiency are combined with extremely low prices, which is rendered possible only by the introduction of improved labor-saving machinery, added to a large increase in our output.

The Transformer we offer is the improved type F. Thomson-Houston design, celebrated for its high efficiency and perfect regulation.

The following points in a Transformer are all essential: (1) Perfect safety; (2) high efficiency; (3) good regulation; (4) small core loss; (5) convenience in installation.

These are attained in the New Type F. Oil Insulated Transformers (which we are now manufacturing at our works at Peterborough, Ont.), in a greater degree than any other upon the market.

Write to nearest office for prices and discounts.

INCANDESCENT LAMPS

We have, during the past two months made such changes and improvements in our methods of manufacture, and in the general appearance of our lamps, that we offer you, with confidence, a lamp that we are assured is now superior to any other in the market.

We have adopted an entirely new method of treating and handling our carbons, and have so improved our methods of inspecting and testing throughout each department and process that all inherent defects are eliminated before the lamps are passed for shipment.

Price list and discounts furnished on application.

OUR LAMP SOCKETS ARE THE BEST AND CHEAPEST IN THE MARKET.

SPARKS.

Inprovements to the Nanaimo, B. C., electric light plant are contemplated.

The Carberry, Man., electric light plant has been sold to Mr. Wm. McMillan.

The Bell Telephone Company have installed an electric fire alarm system at Owen Sound, Ont.

A deposit of mica of excellent quality is said to have been discovered not far from Rat Portage.

The Royal Electric Co., of Montreal, will install an incandescent plant for the town of Mitchell, Ont.

The Legislature of British Columbia is asked to grant incorporation to the Consolidated Railway and Light Company.

Mr. H. N. Rorison has purchased the electric light plant at Moose Jaw, N. W. T. A number of improvements are in contemplation.

We regret to learn that one of our Hamilton subscribers, Mr. W. R. Cornish, engineer, recently had a very narrow escape from suffocation by coal gas.

Mr. Geo. Black gave an interesting address before the members of the Young Men's Christian Association of Hamilton, recently, on "Electricity at the World's Fair."

Damage to the extent of about $10,000 was caused by an ice jam which carried away part of the dam at Caledonia, Ont., on the 6th of March, and rendered inoperative the electric light plant.

An expert electrician has been employed by the City Council of Victoria, B. C., to examine into and report upon the condition of the city lighting plant, with the object of having it put into a condition of efficiency. F

The installation of an electric light plant at Aurora, Ont., is being proceeded with as rapidly as possible. The contract for the electric light station and power house has been awarded to Mr. Walter Machell. The building will be of brick and will be situated on Tyler street.

Messrs. E. O. Champagne, city boiler inspector, O. E. Granberg and E Manney, of Montreal; W. Laurie, of Maskinonge, and F. Grenden and J. Samson, of Quebec, have been appointed a Provincial Board of Boiler Inspectors to examine candidates and grant certificates as boiler inspectors.

A bill is now before the Ontario Legislature to authorize the amalgamation of the various electric lighting companies at Ottawa. Should the bill pass the Legislature, as it is believed it will, the amalgamation will go into effect on the first of June next. It is reported that Mr. Berkley Powell, the present manager of the Standard Electric Company, will in all probability become the manager of the new concern. It is also said that a decision has been come to that under the amalgamation, the cost of lighting shall not be increased, but if possible reduced.

- - JOHN FORMAN - -

650 CRAIG STREET - - MONTREAL

. . . AGENT IN CANADA FOR . . .

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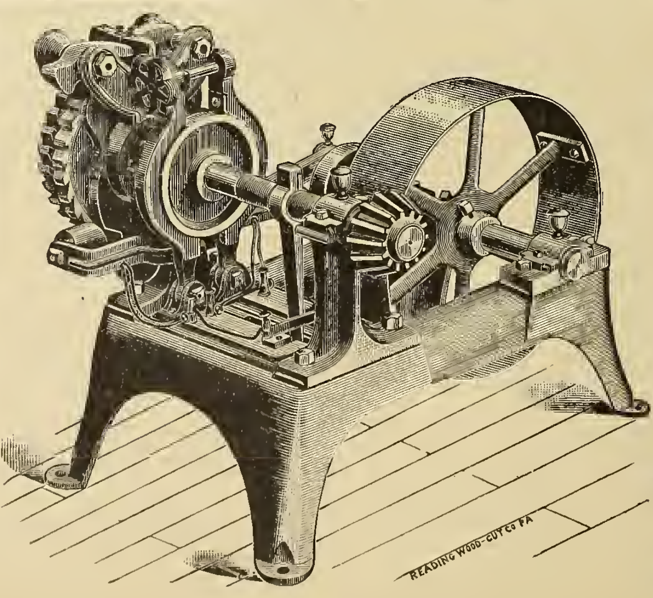

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SPARKS.

The Brantford Electric Light and Power Company have several times of late suffered damage by reason of floods. On the 6th of March, part of their embankment was carried away, and for a time the total destruction of their plant appeared to be imminent.

Application is being made for incorporation by the T. W. Ness Electric Company, of Montreal. The applicants are Messrs. T. W. Ness, T. H. Davidson, J. L. Rankin, J. E. Adams and M. W. McLaren. The capital stock of the company is to be $150,000.

The shareholders of the Montreal Street Railway Company have resolved to increase the capital stock of the company from $2,000,000 to $4,000,000 and have empowered the directors to issue new bonds for this purpose at such times and in such amounts as they may see fit.

Messrs. A. A. Wright & Company's electric lighting station at Renfrew, Ont., is said to be one of the best arranged and kept in Eastern Ontario, everything about the place being maintained in a condition of perfect cleanliness. The credit for this is largely due to Messrs. John Stuart, Wm. Wherry and Howard Wright, who are in charge of the station.

Messrs. Louis Cote, Paul Ryan, Jean Baptiste, Lalime, and Jean, T. Godbout, of St. Hyacinthe, Que., and Antoine M. Morin, of Paris, are applying for incorporation as "La Compagnie des Bouvoirs Hydrauliques de St. Hyacinthe." The object of the company is the production and sale of light, heat and motive power produced by electricity. The capital stock will be $50,000. The gentlemen above named will be the first directors.

A company is being formed to utilize the Falls at Chateau Richer for the purpose of supplying electric light to that town and St. Anne de Peaupre.

A bill has passed the Ontario Legislature, which gives the London Street Railway Company a thirty three yeasr' franchise over the streets of the village of London West.

The Bell Telephone Company will establish a new central station at St. Roch, a suburb of Quebec city, and have had plans prepared by the local manager, Mr. Dauphin, for a new building to be erected at the corner of Caron and Charest streets for the purpose.

At a special meeting of the shareholders of the Merchants' Telephone Company, of Montreal, the directors were authorized to dispose of the balance of the capital stock of the Company, amounting to $20,000. It is stated by the President, Mr. F. X. Moisan, that the company has no intention of selling out to the Bell Company.

The Brockville Gas Light Company is applying to the Ontario Legislature for authority to change the name of the company to "The Brockville Light and Power Company, Limited," to increase the capital stock to $250,000, and to make the charter of incorporation, which expires in nine years, perpetual.

Application will be made to the Dominion Parliament for an act to incorporate "The Dominion Gas and Electric Company," with headquarters at Winnipeg. The capital stock of the company will be $1,000,000. This is said to be the first step toward the consolidation of the Winnipeg Street Railway and the Manitoba Gas and Electric Light Company.

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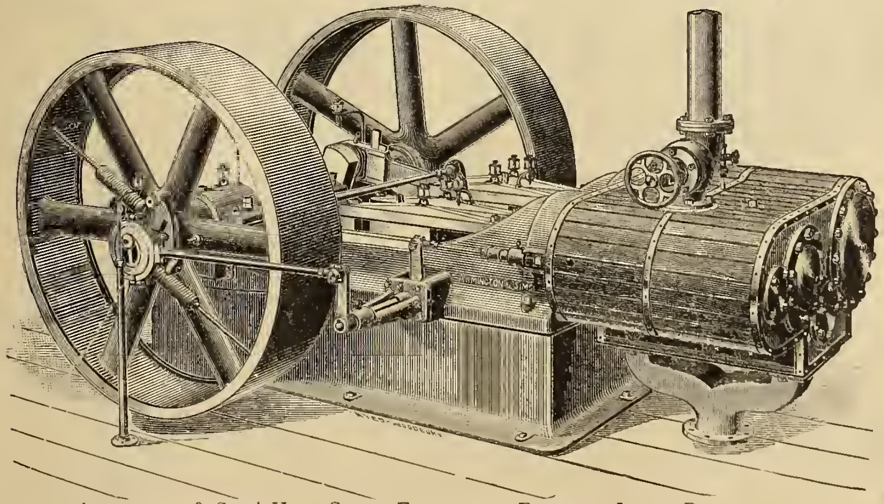

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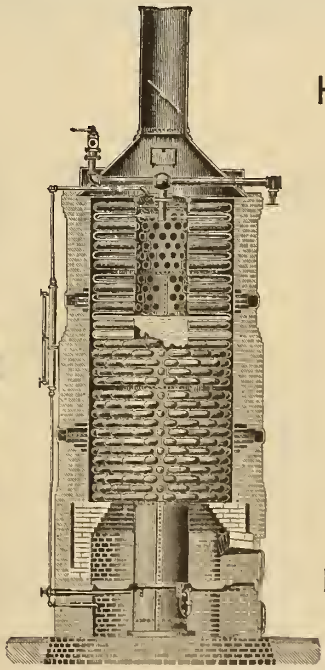

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Descriptive Catalogues of the above on application.

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Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	9.40
1......	P. M. 6.50	A. M. 4.30	9.40
2......	" 6.50	" 4.30	9.30
3......	" 7.00	" 4.30	9.30
4......	" 7.00	" 4.30	9.30
5......	" 7.00	" 4.30	9.30
6......	" 7.00	" 4.30	9.30
7......	" 7.00	" 4.30	9.40
8	" 7.00	" 4.40	9.00
9......	" 7.50	" 4.50	6.30
10......	" 10.20	" 4.50	5.40
11......	" 11.10	" 4.50	5.10
12......	" 11.40	" 4.50	
13......	....	" 4.50	}
14......	A. M. 12.30	....	4.20
15......	" 1.30	" 4.50	3.20
16......	" 2.30	" 4.50	2.20
17......	" 2.50	" 5.00	2.10
18......	No light.	No light.	....
19......	No light.	No light.	....
20	No light.	No light.	....
21......	P. M. 7.20	P. M. 9.40	2.20
22......	" 7.20	" 10.10	2.50
23......	" 7.20	" 11.00	3.40
24......	" 7.20	" 11.50	4.30
25	" 7.20	A. M. 12.40	5.20
26......	" 7.30	" 1.20	5.50
27......	" 7.30	" 1.50	6.20
28......	" 7.30	" 2.30	7.00
29	" 7.30	" 3.10	7.40
30......	" 7.30	" 4.00	8.30
		Total,	169.00

The Council of Nanaimo, B. C., is considering the purchase of an electric light plant.

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PERSONAL.

At the recent annual convention of the National Electric Light Association of the United States, held at Washington, Mr. Frederic Nicholls, manager of the Canadian General Electric Company, was elected to the office of second vice-president. We congratulate Mr. Nicholls upon this recognition of his ability, and the National Association upon the wisdom of its choice.

We learn that W. A. Johnson, for ten years General Manager of the Ball Electric Light Co., Ltd., of Canada, and who has since the sale of the Ball factory to the Canadian General Electric Co. acted as general agent for the latter, has terminated his engagement with said company, and will enter into business again on his own account and engage in electric contracting, engineering and installation work.

The citizens of Belleville, Ont., are agitating for an electric railway. The Mayor estimates the cost of construction at $24,000.

We have received from Mr. C. W. Chadwick, of Rat Portage, Ont., samples of white mice of excellent quality from deposits recently discovered in that locality.

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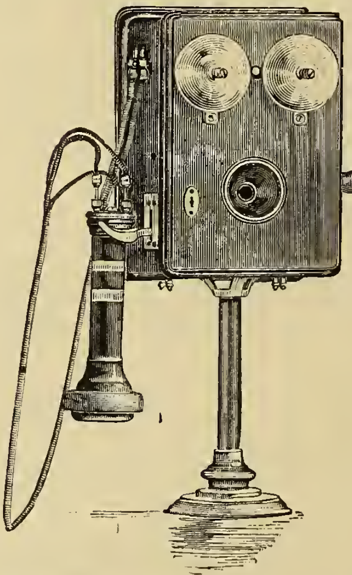

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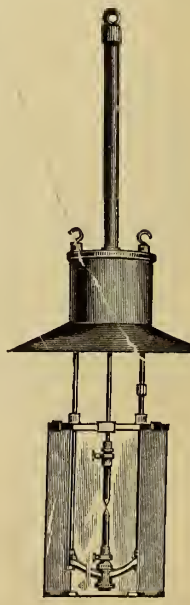
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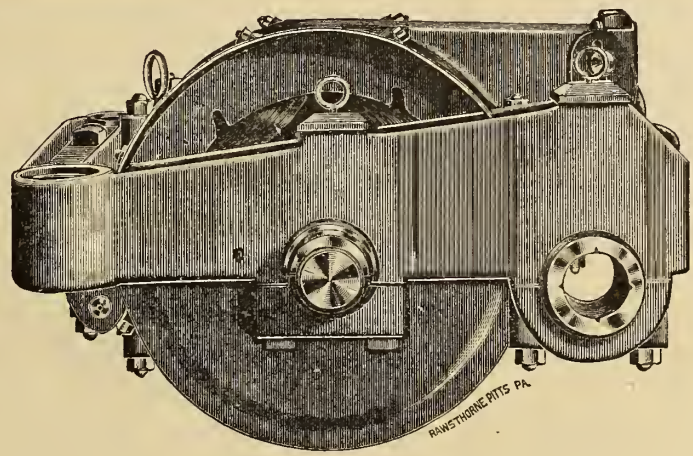

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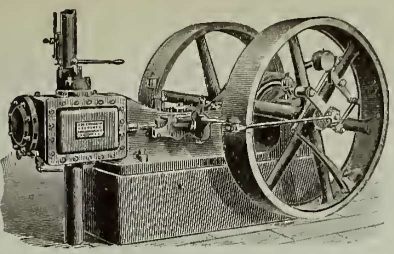

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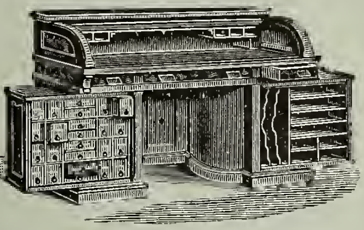

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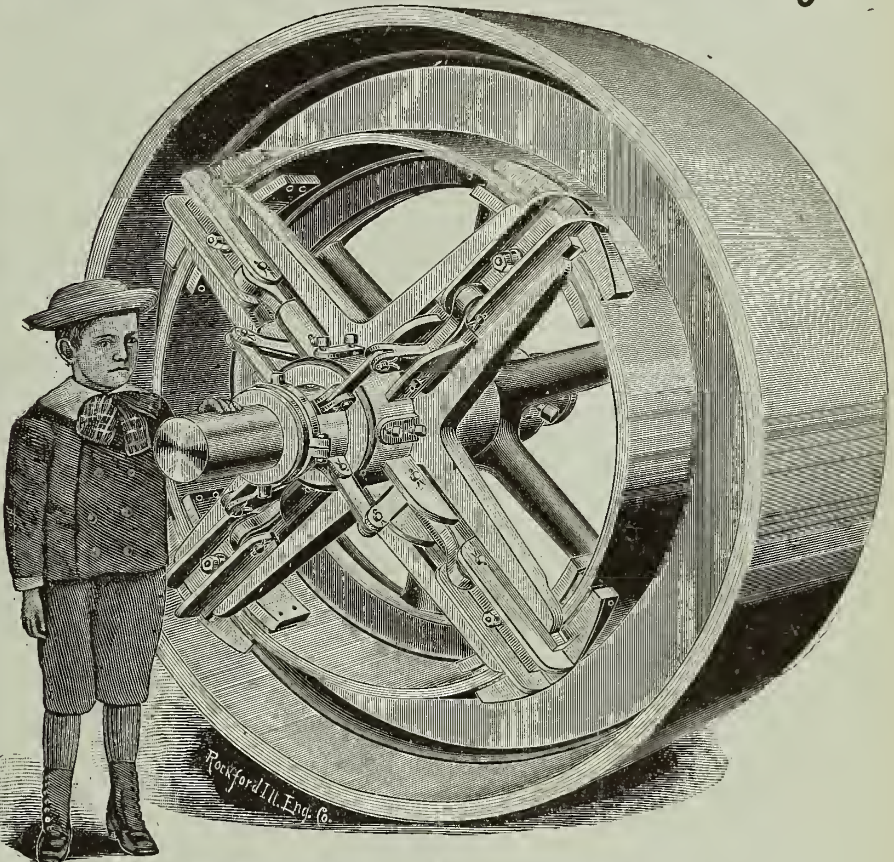

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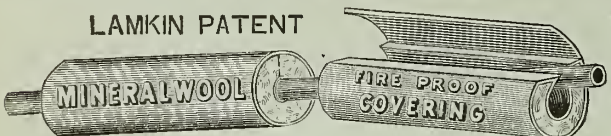

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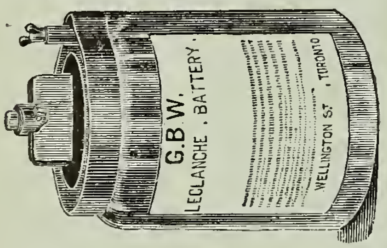
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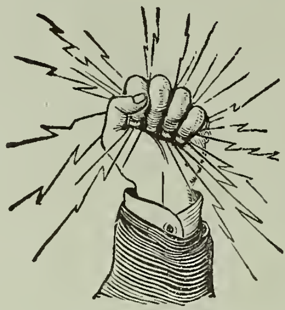

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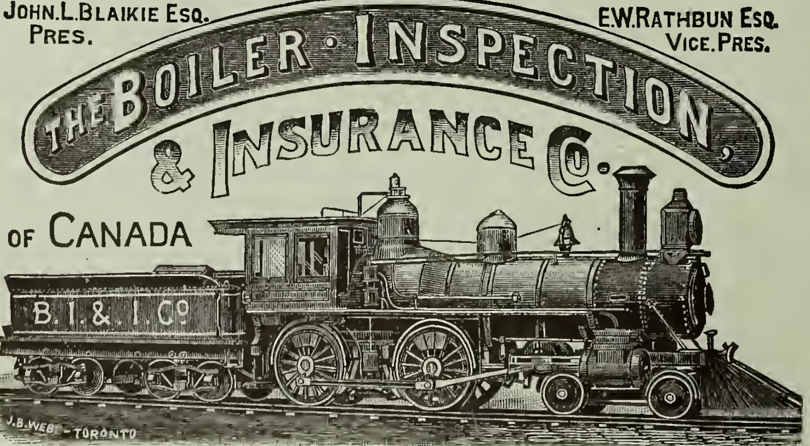
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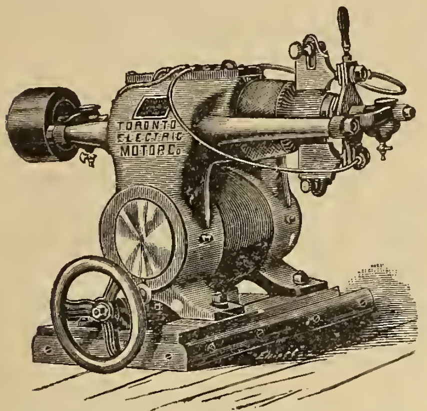
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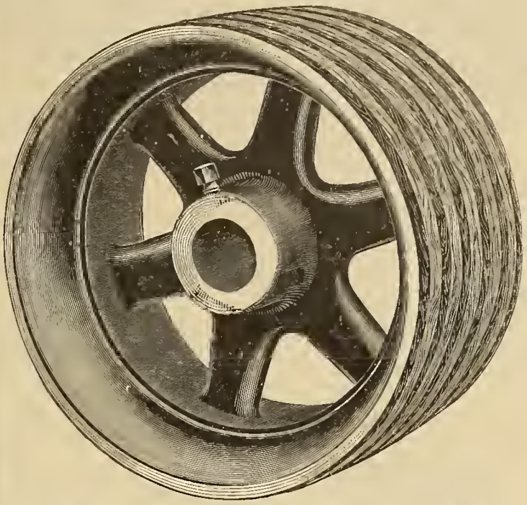

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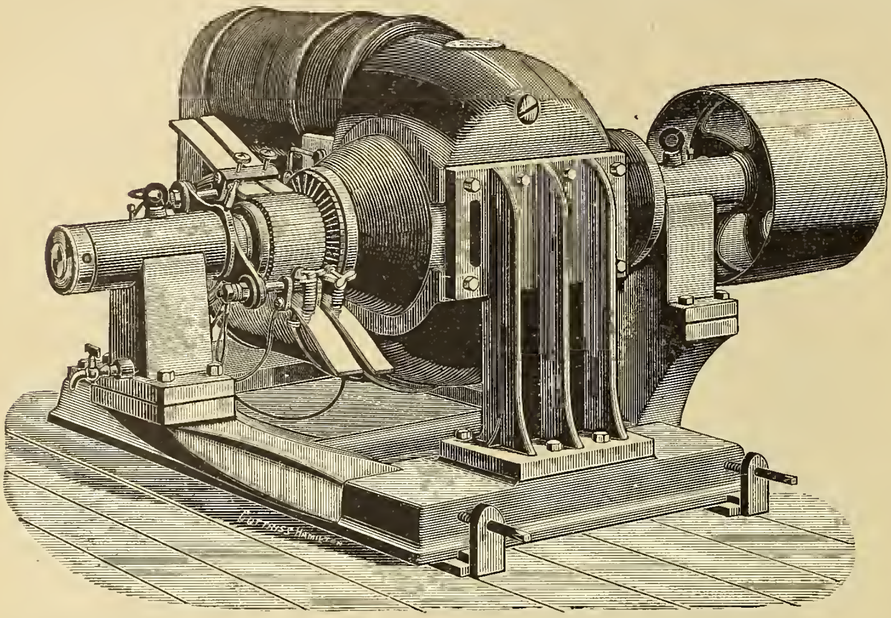

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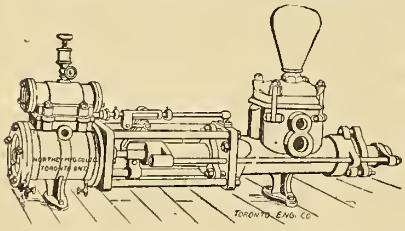
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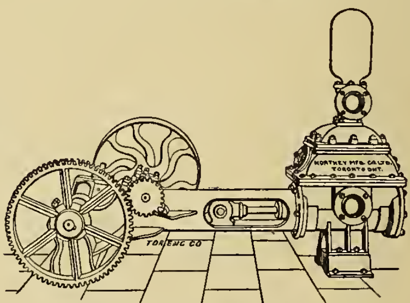
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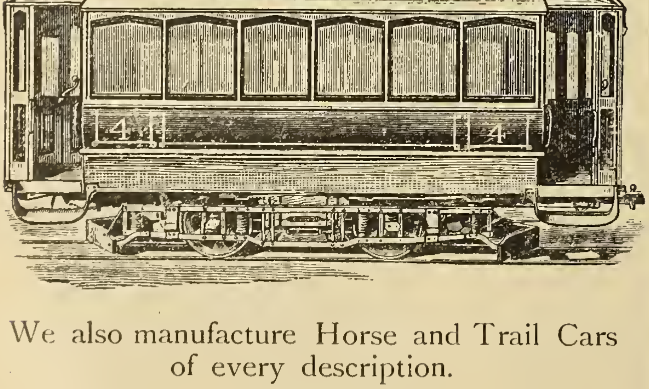

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SAMPLE LETTER.

MONTREAL, Oct. 10, 1893.

MESSRS. T. W. NESS & CO.,
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DEAR SIRS :—In reply to yours of the 9th, we beg to say that we have used one of your Automatic Telephones for some time, and find it satisfactory in every respect.

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CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. IV. MAY, 1894 No. 5.

AN ANCIENT TELEPHONE.

It is a pretty widely-known fact that as early as 1667 the English physicist, Robert Hooke, described the transmission of sound to a very considerable distance. He says that, by the help of a tightly-drawn wire, which even might be bent in many angles, sound might be propagated to a long distance, and with a rapidity which, though inferior to that of light, was, at any rate, infinitely superior to that of sound in the open air. It is a most curious fact, and one which is not so generally known, that Jacob Christoph Von Grimmelshausen, a German author of the seventeenth century, in the first chapter of the third book of his celebrated novel, "Simplicius Simplicissimus," mentions an instrument which, according to his description, not only corresponds to Robert Hooke's apparatus, but leads to the assumption of the existence of a contrivance at the time of the Thirty Years' War very similar to our present telephone. The passage from the book reads literally as follows: "I was, as already mentioned, so eager to gain honour and renown, that I could not sleep while all this was passing through my head. And when I had such fancies, and lay awake many a night thinking how I might contrive new finds and stratagems, I had very curious notions; consequently I bethought myself of an instrument with which I could on a calm night hear a trumpet being blown at three hours distance, and a horse neighing and a dog barking at two hours and a man talking at one hour's distance. In the daytime the instrument was not so useful to me unless it were in a quiet place, because one would have heard the horses and the cattle down to the least bird in the air, or frog in the water, all together, so that one would not have understood one in consequence of the noise of the other. Now, I know quite well that there are people at this very hour who do not believe me; but, whether they believe me or not, it is the truth. I undertake, by means of an instrument invented by me, to recognise at night by his voice a man who does not speak louder than his usual custom. And no one would believe me of those who saw with their own eyes how I used the aforesaid instrument, and when I said to them, 'I hear horsemen galloping, for the horses are shod,' or 'I hear peasants, for the men go barefooted'; then, 'there goes a herd of cattle, for I hear sheep bleating, bulls bellowing, and pigs grunting, and so forth.' My own comrades at first took these speeches for 'fibs,' but when they found in reality that I was always speaking the truth, then they called it witchcraft taught me secretly by the devil's own mother. I am of opinion that if I had taught this science openly I should have become very popular, because it would have proved of great advantage to those engaged in war, especially in sieges. This is what Grimmelshausen says about his 'far-hearing instrument,' to which must be accredited a certain resemblance with the present telephone." —Machinery.

QUESTIONS AND ANSWERS.

C. W. C., Rat Portage, Ont., writes: Can you tell me where the markets for mica are, how it is graded, and for what purposes it is used?

ANSWER.—The principal market for Canadian amber mica lies with the large electrical manufacturing companies of the United States. These companies prefer to use the smaller sheets, and from these, when required, they build up larger sheets to suit their purpose. The principal users of white mica are the stove manufacturers. We understand that the quality in both amber and white, is graded largely according to the size of the sheet. We presume that of course the clearness, etc., would also have considerable to do with determining the grade. Refuse mica is also made use of by paint manufacturers, who grind it up for use in their materials.

E. A., Newmarket, Ont., writes: On page 36 of the Calendar of School of Practical Science for 1893-4, it says; "Candidates for electrical engineering are required to present in evidence that they have had one years practical experience with mechanical works as machinist, patternmaker, etc." As there are several of your readers who would like to know, would you please answer the following questions through your paper: (1) Will this year have to be put in before going to School of Practical Science? (2) Would a year in an electric station answer? (3) Would it do to put the year in four months at a time in the holidays?

ANSWER.—In reply to our request for information on the above points, Professor Galbraith, Principal of the School of Practical Science, writes us as follows:—"The year of practical work required in the case of candidates for the diploma in the department of mechanical and electrical engineering may be put in before coming to the school. Part of the time may also be put in during the vacations, say four months in each vacation. If the whole year has not been put in before the candidate has passed his final examination (3rd year) his diploma is withheld until the time has been completed. A year in an electrical station would be accepted if it were employed in mechanical and electrical work. The object of the provision is to ensure that holders of the diploma in question have had a certain amount of manual workshop training."

The following answer to a question by "Meter," Arnprior, Ont., in the NEWS for March, was accidentally omitted from the April number:—The fan motor which is most extensively used with alternating currents is not essentially an alternating current motor. The principle of its action is a rotary magnetic field produced mechanically. The field magnet is a cylinder with pole pieces spaced equally around it, projecting radially inwards. The armature shaft is the axis of the cylinder. There is a coil round each pole piece and the terminals of these coils are brought to contact pieces arranged in a circle concentric with the shaft. The armature is a soft iron bar revolving inside the field magnet ring so that the ends of the armature bar clear the pole pieces. The circuit is made through brushes carried by the shaft and sliding over the circle of contacts, by which means the pole pieces are energized in rotation and a little in advance of the instantaneous position of the armature. Both field magnets and armature are laminated. This motor will also work on a straight current circuit. Whichever way the current is sent through an ordinary straight current series motor it will always revolve in the same direction. It will therefore also work —though from other causes inefficiently—on an alternating current, if the field magnets are laminated. This is well known and the principle has been used for alternating current fan motors.

MOONLIGHT SCHEDULE FOR MAY.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	
1......	P. M. 7.30	A. M. 4.10	8.40
2......	〃 7.30	〃 4.10	8.40
3......	〃 7.30	〃 4.10	8.40
4......	〃 7 30	〃 4.10	8.40
5......	〃 7.40	〃 4.10	8.30
6......	〃 7.40	〃 4.00	8.20
7......	〃 7.40	〃 4.00	8.20
8	〃 7.40	〃 4.00	.8.20
9......	〃 8.40	〃 4.00	7.20
10......	〃 10.50	〃 4.00	5.10
11......	〃 11.10	〃 4.00	4.50
12......	〃 11.50	....	4.10
13......	....	〃 4.00	
14......	A. M. 1.00	〃 4.00	3.00
15......	〃 1.40	〃 4.00	2.20
16......	〃 2.10	〃 3.50	1.40
17......	No light.	No light.	....
18......	No light.	No light.	....
19......	No light.	No light.	....
20	P. M. 7.50	P. M. 9.50	2.00
21......	〃 7.50	〃 10.20	2.30
22......	〃 7.50	〃 11.00	3.10
23......	〃 7.50	〃 11.30	3.40
24......	〃 7.50	〃 12.00	4.10
25	〃 7.50	A. M. 12.50	5.00
26......	〃 8.00	〃 1.20	5.20
27......	〃 8.00	〃 1.50	5.50
28......	〃 8.00	〃 2.20	6.20
29......	〃 8.00	〃 2.50	6.50
30......	〃 8.00	〃 3.20	7.20
31......	〃 8.20	〃 3.40	7.40
		Total,	156.30

CORRESPONDENCE

HIGH VS. SLOW SPEED ENGINES FOR ELECTRICAL WORK.

Editor of ELECTRICAL NEWS.

DEAR SIR,—Having been an interested reader of the controversy, regarding the best style of engines for electrical purposes, I object to the sweeping condemnation that Mr. Killey gives the high speed engines in your paper. I firmly believe that there is a place for both styles of engine, and that the special place for the high speed engine is furnishing power for plants requiring say 100 h. p. or less. That they are running to advantage in larger plants I am quite willing to admit, but when the power required is more than this I would prefer the slow speed engine. To go back to the high speed argument, my reasons for preferring the high speed for small plants are many, and with your permission I will enumerate a few of them.

1st, In the first place the high speed can be built in the very best manner and sold at from 30 to 40% less than the slow speed of equal power.

2nd, In cost of foundations,—the high speed has the advantage to the extent of fully 100 per cent.

3rd, As regards the floor space occupied—a very important item in most plants—I might instance a private lighting plant in one of our largest dry goods stores in this city—the power being furnished by a 4 valved automatic engine, a beautiful machine but totally unfit for the purpose used. The greater part of the basement of the building is taken up with engine, countershafting and dynamo, and as the room just there is very valuable, the loss of space must be quite an item.

4th, The simplicity of the high speed engine is a most important feature. In a 4 valve engine there is a great deal of mechanism in connection with the valve motion continually wearing and requiring adjustment. There is no class of mechanics that have made greater strides in educating themselves during the last 10 years than the Stationary Engineers,' still it is safe to assume that not ten out of 100 engineers in charge of small plants, say in villages, have an indicator to set their valves with, and an indicator card from some of the 4 valve engines after running a few years is sometimes quite a curiosity. In the high speed engine the valve is as simple as a plain slide valve, and any ordinary engineer can set the valve in a few minutes.

5th, The almost perfect regulation of the high speed engine is also a very important item in an electric plant. Most makers of high speed engines are willing to guarantee a regulation within 2% between full load and no load; now I do not know a slow speed that will do this.

6th, The economy of the engine. I notice that Mr. Killey credits a 6″ × 8″ high speed engine, 14.85 2 h. p. with 3.85 lbs. of coal per hour per indicated horse power. I have seen his report to the builders of the engine, in which he gives the result of the test as 3.58. In either case, high speed men have no cause to be ashamed of the result in an engine of that size, though I quite agree with him in believing that there are many Corliss compounds giving better results. I have known high speed engines to replace 4 valved automatic slow speed engines, with a great saving at the coal pile. I think myself that with an overloaded engine the slow speed would prove the more economical; with an underloaded engine the high speed would have the advantage; and with a fair load there would not be much difference.

In conclusion, let me ask the opponents of the high speed not to confound the properly built high speed engine with the slow and medium speed engine of a few years ago, run at a high rate of speed with hot crank-pins and eccentrics, that were so common with these engines. If the engine is built for the speed with large bearings and crank-pins, and perfectly balanced valves, there is nothing to be feared in that respect.

Yours truly,

"HIGH SPEED."

HIGH VERSUS SLOW SPEED ENGINES FOR ELECTRICAL WORK.

Editor ELECTRICAL NEWS.

DEAR SIR,—I agree with Mr. Killey's statement that commercial appreciation is the best test of the value of either class of engines but the commercial public, and even engineers, do not always appreciate the value of any new thing until it has worked its way into their confidence; and although progress in engineering has always been in the direction of higher speeds, higher steam pressures and more compact form, it is self-evident the attainment of these objects must necessarily present difficulties to the engineer. In the line of locomotive and marine engines, circumstances have forced a rapid development in these directions, and we find engines running at high speeds under heavy steam pressures and in compact form, and in the case of marine engines giving the highest economy in fuel. But in stationary engines the conditions are not so imperative, because it is possible in many cases to use an engine which takes more room; engines having been developed which give high economy in fuel but which are limited by the form of cut-off gear to slow rotative speed, the progress in the direction of higher speed has necessarily been slower than in the other branches referred to, and like all progress is subject to alternate action and reaction, but that there has been steady progress in the manufacture and use of high speed engines in the United States and England during the past fifteen years, cannot be questioned. I think Mr. Killey and many other experienced engineers sometimes mistake the natural demand for larger engines to replace smaller ones for a reaction in favor of slow speed. In regard to the cases cited, where long stroke engines have been put in, it is evident that in most of these cases it was the result of a demand for increased power which enabled the purchaser in some cases to substitute one large engine for a number of small ones, of course resulting in a saving of fuel. And as very few, if any large high speed engines have been built in Canada, and even in the States high speed engines of large size are comparatively new, it was most natural that the best known type of low speed engine would be selected.

In regard to the plant referred to at London, I happen to know that no addition was made to the number of long stroke engines, but simply a pair of Wheelock engines were moved from an older power house to the new one, and one of the engines was replaced by a new one. At the same time two high speed compound engines were added to the plant.

At Windsor, Ontario, two high speed compound engines are being put in to drive a railway and lighting plant, one of which is at present doing the work formerly done by one of the well-known makes of slow speed engine, and is giving better regulation and a considerable saving in fuel. I understand a change is being made in Cincinnati, from low speed to high speed engines for railway work, and tests made at Minnieapolis and St. Paul show, that a railway plant driven by high speed compound engines is more economical than two other plants driven by low speed triple expansion engines. No doubt much evidence could be given on both sides of the question, but as I cannot spare time to go into further discussion of the subject at present, I think I cannot do better than ask you, Mr. Editor, to publish for the information of your readers a tabulated statement made by that eminent and experienced engineer, Dr. Chas. E. Emory, giving the cost of producing horse power by various classes of engines, both high and low speed, including the cost of fuel, attendance, repairs and interest on first cost. This paper simply shows that the total economy does not depend so much upon whether the engine is high or low speed, as upon whether it be compound or simple, condensing or non-condensing, and still more upon the cost of fuel and other conditions. To quote from the report of Dr. Emory's paper, given by the Electrical World: "He (Dr. Emory), therefore concludes that to secure the best results, both electrical and otherwise, in the cities and towns along the line of communication already established, the cheaper engines of simple construction, though not so economical of fuel, will so reduce the capital upon which interests and dividends are to be paid, as on the whole to represent not only better commercial policy, but better engineering."

Yours truly,

D. W. ROBB.

[The table compiled by Dr. Emory, to which Mr. Robb refers, was published in the issues of the ELECTRICAL NEWS for May and June, 1893, and therefore it has not been thought necessary to reproduce it here.—Editor NEWS.]

HIGH VERSUS SLOW SPEED ENGINES FOR ELECTRICAL WORK.

Editor CANADIAN ELECTRICAL NEWS.

DEAR SIR,—A number of your interesting journal having found its way into my office recently, my attention was attracted by a discussion therein as to the relative merits of high or low speed engines for electric light and power work. I have not seen Mr. Robb's letter referred to by Mr. Brown, and do not know just what he claimed for the high speed type. However, it does not require a very extended experience in the installation of light and power plants to convince one that the choice of an engine, for the above duty, depends very largely on conditions which vary for each case, and the fact that a slow speed engine is the more economical or shows a slightly higher efficiency under the most favorable conditions, does not *per se* decide the question in favor of this type.

Careful and most complete tests made recently on a number of engines of both classes, showed, that to produce 500 h. p. with the slow speed engine and its jack shaft, 556 h. p. was required. With the high speed type under same conditions, except absence of jack shaft, but 542 h. p. was called for; both engines were compound condensing. The slow speed, set up ready to run, averaged $30.00 per h. p., and the high speed, $24.50. Both engines were operated under a steady load and the slow speed engine took coal at a rate (with the price at $2.00 per ton) that would amount to $21.97 per annum, while the operation of the high speed would cost, on same basis, $21.51 per h. p., thus showing a difference of 53c. per h. p. per annum in favor of the slow speed type. It will be found, however, that in the smaller units up to, say 300 h. p., the best high speed compound condensing engines will be used in preference to the Corliss type, as the labor required is the same, and the extra cost of the latter engine, together with the greater room taken up by it, as well as the jack shaft, and the fixtures of the same, will more than compensate for the slightly higher efficiency of the engine itself. In the case of a small power plant, having a total output of, say, 500 h. p., with the load constantly varying, say, 75 per cent., which is often the case, and where the dynamos or generating units are small, a more inefficient arrangement could not be well devised than to put in one 500 h. p. slow speed engine, long and usually wobbly jack shaft, with a series of expensive clutches mounted thereon, often fearfully and wonderfully made, requiring frequent repairs, and consuming 10 to 20 per cent. in friction.

Let us consider the above case further, as it is now and will be still more common in your towns and cities. Say five 80 K. W. generators are to be operated and the question of engines arises; two 500 h. p. slow speed engines would be needed, one for spare—these would cost, ready to run, on above basis, $3,000. It will be impossible to keep either of them nearly or quite loaded, and the actual efficiency from this cause, as well as the jack shaft friction, will in nearly every case be found lower than if two 250 h. p. high speed engines are installed, costing $1,225, plus $612 for extra engine, and as one or both of these units can be operated at something near their load at all times and a difference of $1,165 in first cost is in their favor, it can be easily seen why the slow speed type is not used in such cases where the plant has been installed under skilled supervision.

A closer inspection of the cases in the United States, mentioned by Mr. Brown, will show, that in almost every instance the adoption of large slow speed engines has been accompanied by the throwing out of small and use of large dynamos as well—the change simply showing that, owing to increased output, the large units can be operated near their capacity and the best results obtained in efficiency; also the cost of labor is much reduced with the few large units, as compared with a large number of comparatively small engines and dynamos.

As a general rule, it may be said, that the best practice obtaining here is to use high speed compound condensing engines up to about 300 h. p. each unit, nnd where units of 500 h. p. or more can be run under a constant average load of threequarters to full capacity, the slow speed type is demanded. Hoping the above may serve to show the necessity of looking on both sides of a question like this, and regretting my inability to use less space in the endeavour to make the matter clear, I remain,

Yours very truly,
DONALD M. BLISS,
Electrical Engineer, Brookline, Mass.

RELATIVE ECONOMY OF BLAKE AND KILLEY PUMPING ENGINE.

HAMILTON, April 23, 1894.

Editor ELECTRICAL NEWS.

DEAR SIR,—In consequence of a paragraph that appeared in THE NEWS, Mr. G. C. Mooring has placed a report of the test with diagrams from Blake pumping engines in the hands of the Stationary Engineers' Society of Hamilton. These I have carefully gone over, and will assure Mr. Mooring that he is mistaken or misinformed as to the respective marks of the Hamilton pumping engines built here and designed by Mr. Killey, as contrasted with Blake pumping engine now running in Toronto. In reference to report of the test now before me, he states that no such duty as shown by this test can be shown for Hamilton, Kingston or London pumping engines. If this gentleman had taken the trouble to inform himself more fully on this question I am satisfied he would not have written as he has done in THE NEWS.

The test of the new Hamilton pumping engines took place in Feb., 1888. The test was a very exhaustive one as will be seen from a paper of that date in which the whole test is published and which is now in the writer's possession. The test was conducted by Messrs. Worswick and Jones and occupied 14 days. The actual duty of the test of the first engine tested was 114,566,991 ft. pounds per 100 lbs. of coal burned under two 54″ x 14′ boilers, no deduction being made for cinders, ashes, clinkers, steam for feed pump or steam in radiators for heating engine room. This duty was from coal carefully weighed before being used. The duty given by Mr. Mooring as being that of the Blake engine in Toronto, was not the duty per 100 lbs. of coal, but was for 115.5 lbs. of coal, as the amount of waste, including cinders, ashes, etc., in 100 lbs. of coal was added to the coal, making it 115.5, or nearly so, instead of 100 lbs. By this method of calculation, the duty, in the case of the Hamilton engine, exceeded that of the Blake. This refers to test of the first of the new pumping engines in Hamilton. The test of the second engine was conducted when the first engines were running. It also had two boilers of the same size as the others in use. Every precaution was taken as in the first test. The duty of this engine was 118,398,800 ft. lbs. per 100 lbs. of coal, no deduction having been made, as in first test.

If the duty of this engine had been calculated as in the Blake test, it would have been nearly 4,000,000 ft. lbs. in excess of the Blake engine. It is but fair to say, Mr. John Galt, C.E., in his record of the test does not claim the duty per 100 lbs. of coal stated by your correspondent, but gives the duty as per 100 lbs. of conbustible—quite another thing—the correctness of which I have no doubt of.

This letter is not written in disparagement of the Blake or any other engine, but simply to supply facts with regard to Mr. Killey's engine here. I may add that these pumping engines have run night and day since their erection, keeping up their record of a very high duty without break-down or stoppage, and now after nearly six years in use are in perfect order. Hoping you will excuse this rather long explanation,

Yours respectfully,
ROBERT MACKIE.

THE EVOLUTION OF THE STEAM BOILER.

BY J. H. KILLEY, HAMILTON, ONT.

[This communication is the result of observations made by the writer during his engineering career.]

When quite a young man serving my time in a Liverpool ironworks, I had many opportunities of seeing the various classes of steam boilers then in use. From that time to the present, having a natural inclination for the practice and study of mechanics, I have retained most of the information gleaned then and up to the present time. Soon after going to my trade I had occasion to go on board of the steamer "Mars," belonging to the Liverpool and Dublin Steam Packet Company. Steam was up. I asked the engineer in charge what steam pressure he carried. He went to the front of the boiler on which was fixed a bent iron tube in the shape of a V. From the open end of the tube there projected a stick of wood about 8 inches high. He measured it and said $3\frac{1}{2}$ lbs. there, and $\frac{1}{2}$ lb. to the square inch. I asked him if that was all the pressure he carried when on full steam. He said, "yes, I cannot carry any more, if I did the mercury would blow out of the tube,"—this was his steam guage, there being, so far as I know, no guage at that time such as we have now.

It was years after that before I was made acquainted with a clock-faced guage. The stick the engineer measured was resting on a column of mercury inside the bent tube that raised and lowered it as the pressure of the steam increased or diminished in the boilers. At this time steamers belonging to the British Government ran the mails between Liverpool aud Dublin. I recollect them well, as they were the crack boats of the day, and were named the "Urgent," the "Medina" and the "Medusa." They were commanded by lieutenants in the Royal Navy, and had the reputation of going out and making their passages in all weathers. A circumstance in this connection that may amuse your readers, was narrated in the Liverpool papers of that time. One night the Urgent was at the old George's Dock landing stage taking on the mails and passengers for Dublin. It was blowing a hurricane at the time. Lieutenant Williams in command was on the bridge. The captain of the landing stage asked him if he intended to go out. He said, "yes, it is for H— or Dublin this night." An old quaker and his wife were going up the gangway at the time and heard the remark, and turning back said, "thee can go then if thou will it, I will not accompany thee." The steamer, however, made the passage safely. The steam pressure carried on these boats did not exceed 10 lbs. to the inch.

At the time I speak of a British Government steamer named the "Rhadamanthus," was getting her engines and boilers placed on board. She was a paddle boat, there being no screw steamers in the service then. The pressure in the boilers with full power was 10 lbs. to the inch. There were no boilers at that time such as are built for steamers now. The shells of the boilers were great rectangular boxes with furnaces placed in square flues that traversed the boiler three or four times, and thence to the uptake and chimney. The first eight Cunard trans-Atlantic steamers had boilers of this kind. All were paddle boats. They made an average of $8\frac{1}{2}$ miles per hour on their trip. All had side lever engines. They carried from 15 to 20 lbs. of steam; steam being made from salt water. It was not practicable to construct them in the same manner as at present, as large spaces had to be allowed around the furnaces to receive the salt deposited in them, surface scum pipes not being then in use—only the bottom blow-off. Neither were there surface condensers.

The locomotive multitubular boilers were in the same form or nearly so as when we have them now. There were no multitubular boilers on steamboats until the surface condenser came into use, yet for a long time after the adoption of these condensers, and with an improved form of boilers, the pressure was not increased to more than 25 lbs. until after the adoption of compound engines. The large saw and other mill engines in Liverpool ran with not more than 10 to 15 lbs. of steam. They were all walking beam engines of ponderous design, and did not have a piston speed of more than from 180 to 200 feet per minute, same as the steamers.

To feed the boilers with water, a pipe stood up above the shell some 20 feet. On the top of this pipe was a small cistern in which was placed a valve operated by a stone float in the boiler balanced outside. As the water went down this float opened the valve, and so kept the water at a level in the boiler, the head of water in pipe being sufficient to overcome the steam pressure. Of course these engines were all condensing. With 10 lbs. boiler pressure, an average pressure of 20 lbs. was received on the engine pistons. The fuel consumed was from 6 to 8 lbs. per h. p. per hour.

Returning to steam boilers, there were two classes used for stationary work in cities at that time. The most generally used for high pressure engines then coming into use were plain cylindrical egg-ended ones. They were cheaply constructed and could be easily cleaned out. They were fired under the bottom and had a wheel draft all around the sides. They were not economical of fuel, as they did not evaporate more than 5 lbs. of water per lb. of good coal.

The other boiler in use was called the Lancashire, and was generally from 26 to 30 ft. long, with two internal furnaces of circular form. Modifications of these boilers are still in general use in the English manufacturing districts. It is claimed for them that their economy of fuel is equal to the multitubular boiler in common use now. A number of these boilers imported from England within the last few years are in use in Canada. Frequent disastrous explosions of these boilers took place, and were looked upon as mysterious, until Mr. William Fairbairn demonstrated that their strength was inversely as the length and diameter of their furnaces. This brought about an improved form of furnace with strengthening rings. Since their introduction and the general adoption of steam boiler inspection, explosions have become very rare. · In my younger days, Charles Wye Williams, a consulting engineer in the employ of the City of Dublin Steam Packet Company, was engaged in experimenting on steam boilers, with a view to their greater efficiency and the prevention of smoke. I had an opportunity of seeing one of his boilers tested in the yard of the City of Dublin Company, Liverpool, under M. Williams' superintendence. Although his furnace was shown to prevent smoke to a great extent, it did not come into general use, as it was not shown that it was more economical than those in use. I may however state, that Mr. Williams constructed a fire-box boiler of the locomotive type, the tubes of which were 8 ft. long, divided into eight water-tight divisions, the first division being 6 inches from the fire-box tube plate. The result of this experiment showed that the firebox made more steam than the balance of the boiler, and the first 6 inches of the tube more than all the rest—the two last divisions making no steam, as the temperature of the water in them could not be raised to the boiling point.

About the same time the Stephenson long boiler locomotive engine was constructed, with very long tubes. It was not found to make steam any better than the short boilers, and its manufacture was soon abandoned.

In the colliery districts of Lancashire, the haystack and waggon boilers then in use did not run with more than $1\frac{1}{2}$ to 2 lbs. of steam. The pumping engines had open topped cylinders, the steam being used to displace the air, and then condensed by a jet of water in the bottom of the cylinder, the pressure of the atmosphere on the piston doing the work of pumping. The boys used to amuse themselves by getting on the beam and piston when the engines were in motion, the strokes not being more than 3 or 4 per minute. I have been informed that some of these engines and boilers are still at work in the colliery districts.

When multitubular boilers first came into use for stationary purposes, the manufacturers placed too many tubes in them, and kept them too close to the shell bottom over the fire. As a consequence they gave a large amount of trouble, the shell plates giving way and getting hot through the want of proper circulation of the water. The writer was often asked at that time as to the cause of the trouble. I showed the impossibility of the water getting down on the furnace plates while the large body of steam was ascending through the tortuous passages around the tubes. I have seen a new boiler constructed this way, and made of the best lowmoor iron, give out entirely in two weeks, while those that were constructed with sufficient space for circulation, worked very economically and gave no trouble whatever.

The matter of circulation of the water and liberation of the steam was exhaustively experimented on by Mr. Robert Isherwood, Chief Engineer of the United States navy, on the steamer Michigan of this navy. This gentleman caused a reduction of the number of tubes in the boilers by about one-third, reducing the consumption of fuel, and increasing the steam available to propel the ship—clearly proving that increased circulation of water in a steam boiler largely increases the production of steam and adds to the life of the boiler.

A new steam boiler was built and placed in position in a foundry and machine shop in Toronto in 1867. The owner designed it himself and filled it close to shell and bottom with tubes. In one month it had to be replaced by a new one, as it bagged over the fire until the plate split. It made very little steam considering its heating surface. I saw this boiler before it was set in brickwork, and told them what might be expected. The same thing happened from the same cause to three boilers in Hamilton. Repeated failures of steam boilers from this cause has taught a lesson to the manufacturers that has passed through the trade, so that most of the boilers are now not deficient in this respect.

When I went to Liverpool to serve my time, there was no official inspector of boilers, engines or steamboats, nor any examination of or certificates given to steamboat engineers, the managers or the owners of the boats taking the best or cheapest men from the shops, or from those that had raised themselves from firemen in the boats. Neither were there any boiler inspectors on shore, or boiler insurance companies. As a consequence, explosions and loss of life were very frequent, very much more so than at the present time when there are boiler insurance and inspection companies always available.

I recollect going into a factory on Sparling Street, Liverpool, at the dinner hour; I saw a man sitting by a steam boiler with two heavy weights on the lever of the safety valve. I said to him, "what have you the two weights on for?" He said, "Mr. Twiss told me not to let the steam blow off, it rusts the machinery." I told him to lift it up gradually until it let all the steam out that would come out, leaving the old weight on, and made off down the street as quickly as possible.

I have met many men in this country in charge of boilers who had very little more knowledge of steam than this one. Any man in charge of steam boilers can now have no excuse for his want of knowledge in this respect, as he may join the Stationary Engineers' Society, and receive necessary instruction that would fit him to take charge of any land engine or boiler without fear of accident.

I do not understand how it is, looking to the many boiler explosions that take place in Canada, with the consequent loss of life and property, that the Ontario Government can not be prevailed upon to pass a law making examination of engineers compulsory, as also inspection and tests of steam boilers. Perhaps the lives saved by a law would not be a sufficient set-off to the political patronage but from those who selfishly oppose getting such a law.

This letter is, I am afraid too long; I am therefore constrained to stop here before being through with my subject. By your leave I will return to it in a future number, when I hope to relate some experiences with engines and boilers that your readers were not previously conversant with.

THE EASTON ARC DYNAMO AND LAMPS. *

By T. F. Pickett.

The invention of the Easton system of arc lamps is due almost solely to the efforts of Mr. Jas. W. Easton, who designed and perfected the system. He was employed at first by the Ball Electric Light Co., of Canada, in London, Ontario, and afterwards by the Ball Electric Light Co., of New York. During this service he suggested many of the distinctive features which made the Ball dynamo a practical and commercial success. So far as was desirable these features were incorporated in his subsequent work, and for this reason the external appearance of the Ball and Easton dynamos is somewhat similar.

The fragility of parts inseparable from a profitable manufacture of a double armature machine gave endless troubles from break-downs, and Mr. Easton was certain that a better type could be designed. With that end in view he studied the defects of all the dynamos under his observation. The "burning out" of armature sections was the first defect he succeeded in overcoming, after he awoke to the fact that his previous work had been calmly appropriated by others. This defect was ordinarily due to a defect in the commutator, seldom occurring from an inherent armature trouble, and the device for overcoming it consisted in connecting the armature in a closed circuit, independent of any external connection to the *commutator*, and making the connection between the armature and commutator by fusible wires.

By the accompanying diagram it is seen that the current flowing through the armature wire does not flow out past A2, unless the brush is in contact with C2, and therefore F2 carries current only while the brushes make such contact, which is about 1-60 part of the time, and the fusible connections are adapted to carry about 1-60 of the normal current of the dynamo. If a short circuit is formed as between C1 and C2 the current generated in the wire between A1 and A2 flows in this short circuit through the fuses for the *whole* time, and therefore if the short circuit has sufficient resistance, so that only the normal current flows through it, the fuses will be subjected to about 60 times the normal heating effect and will blow out, but as the short circuit is usually of low resistance and the current abnormally large, the heating effect is increased in the fuses as well as in the armature coil and the fuse blows at once, so that the protection is the more rapid as the possibility of damage is increased. In actual tests, there is no appreciable lapse of time between energizing the magnets, and blowing of fuse, when the short circuit is practically of no resistance. The two short circuited plates in the commutator become practically one and two sections in the armature operate as one section of double length connected and protected by the fuses F and F2. The number of sections being large, the consequent increase of spark at this double section is not destructive; in fact machines have been knowingly operated for months with a number of fuses out, without any serious damage to the commutator, so that there is no necessity to shut down for a short circuit in the commutator of this machine. The next most noticeable improvement was the automatically tightening armature mounting device. The need for such an improvement was pressed upon the inventor's attention from the trouble experienced in mounting the smooth "Gramme ring" armature, which has been so satisfactory for high tension work. These armatures when mounted upon the ordinary spider, *would* get loose and cause wires to break, and the whole armature would sometimes move bodily "out of centre" and strike the polar faces of the magnets. As the causes of loosening were almost solely attributable to the shrinkage of the insulating material in the mounting, and compacting of the armature wire, the correction could be practically uniform all around in "taking up the slack." The device for overcoming this defect consists in making the shaft itself, a single screw bolt the strain of driving the armature being perpetually applied to force a conical nut or cone into a conical seat, and thus expand the insulating material, against the inner surface of the armature, and any looseness is at once taken up by a relative movement of the shaft and mounting. As the shaft is dead true, the running gear can turn upon it without altering the centre of motion, or the balance. Actual experience proves that the shaft, with a screw of two threads to the inch, gains about one turn in the first ten millions, and this tightens everything up solid, the relative motion of the two parts being very slow thereafter. The result of this device has been to effectually overcome the troubles which called it into existence.

Another radical departure from the known types of machines, was the one intended to secure the maximum action from the minimum of material in the armature core. This consists in placing the polar faces of the magnets so that the centre of the armature is subjected to the direct inductive action of both poles, while each end is subjected to the direct action of one only, and the indirect action of the other. The theory for this is found in the fact that the self repellant action of magnetic lines of force have similar direction of flow, causing the ends of a cylinder subjected to a uniform distribution of inductive action to become saturated first and requiring expenditure of energy to get the centre saturated under these conditions.

The same property of magnetic lines of force also causes the ends of a magnet polar face to be the strongest in effect, and the inductive action to be non-uniform with the same tendencies already existing in the armature core.

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* Paper read before the Montreal Electric Club.

Placing the magnets in the positions as described applies the most powerful action to the centre of the length of the cylindrical core, and thus utilizes the self-repellant properties to secure a uniform and practical distribution throughout the entire core.

These three devices are the original patented and specially distinctive features of the Easton arc dynamo, while the proportioning which was effective in securing a steady current through the notably unsteady resistance of arc lamps was also important, although not deemed patentable, the secret of it has been independently discovered and is now fairly well known. I believe Mr. Easton was the first to realize the effect of armature re-actions in a dynamo and utilize them intelligently for a definite purpose. The voltage of this dynamo with fixed brushes, speed, and number of turns effective in magnetic field, is actually highest at about three-fourths of the normal working current, consequently a change of resistance does not have a bad effect on the lamps as the tendency is self-corrective to a marked degree. The reasons for this are, that the magnet coils practically saturate the magnetic circuit at three-fourths of the normal current, and any increase of current affects the excitement very little, while the armature re-actions become more energetic and actually reduce the lines of magnetic force passing through the armature. Any decrease of resistance tending to an increase of current, is partially checked by the decrease of induction in the armature, and any increase of resistance tending to a decrease of current is partially checked by the increase of induction due to armature re-actions, unless the resistance becomes so great as to affect the energizing power of the magnet coils, and so the unsteady resistance of the arcs is met by a corresponding unsteady voltage, which is equally quick and corrective in influencing the volume or amperage of the current, which is therefore fairly uniform under regular conditions.

The recent developments and improvements on this machine are valuable additions to the features before described, the oil reservoir and ring oiling bearings being more cleanly and far more reliable than either grease or oil cups, and require much less attention. An automatic regulator or controller is also attached to the latest type. The regulator operates entirely different to anything yet placed on the market.

The dynamo may be run with or without it as desired, as it is independent of the machine itself. The brushes remain stationary for all variations of load, and the machine may be run on a short circuit for any length of time without any injurious results; in fact with this controller, a machine running at full load may be short circuited by placing a wire directly across the terminals, with no other effect than a slight increase in the spark at the brushes for a few moments. This increase of sparking is probably due to the fact that it takes a small space of time for the magnetic strength to be reduced or changed in the iron of the machine, as the regulator is instantaneous in its action for any change of the load. The dynamo also has a lower internal resistance with a light load than with a full load, and therefore runs cooler on the light load, although the ampere output is the same. This is a contrary state of affairs to that experienced with most arc machines, as usually when they are cut down below one-fourth of their full load, they run decidedly warmer.

The arc lamp of the Reliance system is a very simple form of the "Alteneck" type, probably the simplest form in use to-day. The use of dash pots is avoided by proportioning the coils and core somewhat analagous to that giving steadiness to the dynamo current. The automatic cut-out in this lamp is simply a pair of contacts, one of which is fixed and the other is attached to the movement frame in such a manner as to make a contact after the frame has passed beyond the point at which the lamps should feed freely. The special feature of the feed movement is the arrangement of the escapement wheel and pallet, wherein by varying the distance between the centre of motion of the wheel and that of the pallet, the movement locks and prevents the pallet from vibrating, allows it to vibrate slowly, or rapidly or to disengage all together, according to the relative position of the wheel and pallet; this position being regulated by the relative power of the shunt and series coils. This lamp is, however, being partially superseded by the "Universal Lamp," which is also one of Mr. Easton's productions. It has been suggested by some that this lamp ought to be called a constant potential lamp, as the voltage remains constant, while the current may be varied from 4 to 12 amperes. This feature allows the candle power of the the lamps to be varied at will by the attendant in charge, without any adjustment of the lamps themselves. It also provides a lamp that will work on any of the high tension arc systems at present in use without any change in the windings or adjustment. The lamp is very compact, substantial, and light, weighing about 25 lbs. complete with globe and hood, making it desirable for use on pole brackets, especially where they are required to extend well out from the pole, or where they are to be suspended in the middle of a street.

The early history of the system dates back to about 1884, when Mr. Easton in company with H. W. Spang, of Reading, Pa., built an experimental machine of the offset pole type. This was a constant potential machine wound for an output of 25 amperes at 70 volts, and was used to light the experimental shop at Reading. The second machine finished was also of the constant potential type wound for 40 amperes at 200 volts, and was used for a number of years for charging storage batteries and for operating 4 arc lamps in series, with the usual resistance, at the Highland House Park, at Reading. The third dynamo completed was built for 5 arc lights, and was perfectly satisfactory in every way. The next machine was built for 35 arc lights and with this dynamo they had a "circus."

The armature re-actions in this machine were very desirable, as they assisted in the maintenance of a steady current, but the sparking was too severe to ever be durable. The cause of this was not fully realized at that time, and the inventor was very much discouraged at not being able to prevent it. As a last resort he hit upon the idea of the double brush. The actions of the double brush are two-fold, the first and chief being that enough sections are included in the short circuit from brush to brush, to give enough E. M. F. to get a current flowing in the coils so that they left the lead brushes in an active condition ready to take up their normal work. The polar effect of the armature coil was also distributed over a larger area, and the effect of commutation was much less sharply defined. The result was all that could be desired. This machine was run for a short time at the Scott Foundry in Reading, and was very successful in its operation.

After these experiments had been concluded. Mr. Easton came back to Canada, and succeeded in organizing the Reliance Co., who began the manufacture of the Easton apparatus in Waterford, Ont. The first machine built by them was sent to a town in Eastern Ontario and was operated by the local company for commercial lighting. This machine is still in operation, and has had but few and trifling repairs with one exception. This exception illustrates what small events are sometimes the vital keys to a situation, and what presumably honest men will do to save money. This dynamo ran splendidly for nearly a year, and then it and a mate which had only been in operation for 4 months, both made a clean burn-out, a perfect roast. Easton went down to get at the facts, but could see no satisfactory reason for the accident, nor would the dynamo tender or owners advance anything that would clear it up. Easton prepared to leave the town in despair; as he did not know the cause he could not devise a remedy. Just as he got on the bus for an early morning train the porter said to him: "There was a funny thing happened the other morning; when I went out for the one-thirty train, the lamp in the front of the confectioner's was lit, and it was the only light in town." As they were eight hour lamps, and the plant was being started at about 5 p.m. and supposed to shut down at midnight, it seem funny to Easton also, and it flashed upon his mind that the dynamo tender had gone asleep and left the water all on (the plant being run by water power), that the lamps had burned out one by one until this particular lamp was the last one to go out, and that the water necessary to run 60 lamps would soon roast out a machine. He then went back and jumped on the dynamo tender, asking him how he came to go to sleep, naming the exact time. He made no attempt to deny it, and replied that he got a shock and got knocked out, He claimed that he fell, and in falling put one hand on each terminal of the machine, and to have recovered his senses about 4 a.m., but as he was caught several times afterwards drunk and asleep, for which he was finally discharged, and he had no sign of a burn on his hands, the probability is that he lied, and that he slept until daylight. As the dynamos ran about two weeks after that without special trouble, the owners had all hoped that no damage had been done. This is at once an example of the staying powers of the Easton dynamo and the importance of the close observance of small things.

This discovery revived Easton's hopes, in fact more than re-assured everybody concerned that the machine were all right. A short time after this the Easton Electric Co., of New York, was formed, and the manufacture of the machines in the U. S. was begun. This company while never going into business on a very large scale, installed quite a number of arc plants in different parts of the U. S., nearly all of which have been in successful daily operation ever since. During the two years in which I was employed by this company, I saw but one armature in the shop for repairs, and this one had evidently been ill treated for upon taking it to pieces, we took several pounds of coal dust out of the inside of it. The last lighting plant I had charge of had two of these machines which were run most of the time from 5 p. m. to 7 a. m., and about all the attention they required was to see that the grease boxes were full before starting and to trim and re-set the brushes once a week in fact the brushes often ran two or three weeks without touching.

In conclusion, I beg to thank you all for the attentive manner in which you have listened to me, and hope you will excuse any mistakes or omissions which I have made, and that this paper has been of interest to everybody present.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of the various Associations are requested to forward to us matter for publication in this Department not later than the 20th of each month.

HAMILTON NO. 2.

On the 22nd of March the annual dinner of the above Association was held at the Commercial Hotel. The President, Wm. Sweet, presided, the vice chair being occupied by Wm. Morris. Quite a number of the Toronto brethren were present as well as some from other points who ably responded to the toast to "The Sister Associations."

The executive officers spoke encouragingly of the advancement which the Association is making, Bro. Edkins giving particulars regarding the organization of several new Associations at the present time.

The usual toasts were heartily responded to and a number of songs well rendered. Altogether, the evening was, in the opinion of all present, a most enjoyable one. I have been requested by the Association to state that the question which recently appeared in the ELECTRICAL NEWS concerning the new Blake pumping engine at Toronto, was not, so far as known, preferred by any member of this organization; and further that no correspondence is sanctioned by this Association which is not signed by the corresponding secretary.

WM. NORRIS, Cor. Secretary.

[The above correspondence arrived too late to be inserted in our April issue.—ED. E. NEWS.]

ORGANIZATION OF KINCARDINE ASSOCIATION NO. 12.

Mr. A. M. Wickens, writes, that on the 21st of April he visited Kincardine, and effected the organization of Kincardine Association No. 12.

The following members were duly elected and installed as officers for the ensuing term:

President, Bro. Joseph Walker, Chief Engineer Water-works; Treasurer, D. Bennett; Financial Secretary, A. Scott; Conductor, R. Murker; Door-keeper, J. Carroll.

There were also present, Bros. Percy C. Walker, J. Gillespie, A. T. Scott and Wm. Carey.

It is a pleasure to learn that while in point of numbers this new association may not equal the older ones, its career, judging by the enthusiasm and character of the membership, will be a successful one.

MONTREAL JUNIOR ELECTRIC CLUB.

Regular weekly meetings of the above club were held on the dates following, at which papers were read on the subjects named:—

March 26th.—Paper by E. W. Sayer, on a general review of past papers.

April 2nd.—Paper by R. H. Street, on Storage Batteries, 1st part.

April 9th.—Paper by S. W. Smith, on Arc Lamp Cut-outs, switches, etc.

April 16th.—Paper by Wm. T. Sutton, on Annunciators and their construction.

The Royal Electric Co., have recently sold to the T. Eaton Co., Toronto, a 600 light direct current dynamo, and to Mr. H. Cook, of Hensall, Ont., a 400 light alternating plant.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal

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Information regarding examinations will be furnished on application to any member of the Board.

NOTICE OF REMOVAL.

Subscribers and advertisers are asked to note that on the first of May the Branch Office of the CANADIAN ELECTRICAL NEWS in Montreal was removed to the New York Life Insurance Building.

ELSEWHERE in this paper will be found the report of a committee of the National Electric Light Association showing the average consumption of fuel in electric stations in the United States. The report indicates that in the electric stations across the line, the highest point of economy in the use of fuel is yet far from being reached. We would be pleased if some of our readers would tell us to what extent the consumption of fuel in electric stations in Canada corresponds to the figures given in this report. There are few subjects which might more profitably be discussed than the means which should be employed for the purpose of securing the greatest amount of power with the least consumption of fuel. Who will be the first to give his experience on this line?

IT is announced that the government will introduce a bill providing for the inspection of electric light meters, and that it is not the intention to appoint any additional officers to carry out the workings of the bill. The necessary inspection is to be done by the present gas inspectors, and the inspectors of weights and measures. This economy is commendable, in spite of the drawback that these officials are quite ignorant—and likely to remain so—of the principles on which electric meters operate. But the two classes of officials selected show that the department has devoted some anxious thought to adapting the means at its disposal to the end to be attained. The Edison chemical meters, which measure by weight of zinc deposited by the current, will fall naturally to the lot of the inspectors of weights and measures, and as the deposit is weighed by milligrammes the inspectors will find their new duties comparatively light. On the other hand the Thomson and Shallenberger dial recording meters have such a strong external resemblance to the gas meters, that the gas inspectors will feel quite at home—if they wisely refrain from looking inside. In view of this evident effort to please, criticism would be unkind. The notice posted in western concert saloons, "Please don't shoot at the pianist, he's doin' the best he knows" applies to this case; and so long as the manufacturers maintain the present standard of of meter accuracy, these novel electricians, if they do no good, can at least do little harm.

A MEETING of the Executive Committee of the Canadian Electrical Association will be held in Toronto a few days hence, when the preliminary arrangements for the annual meeting to be held in Montreal next September, will be considered, Members of the Executive will be notified of the date, time and place of the meeting, and it is hoped they will all endeavor to be present. Much of the work in connection with this convention will necessarily devolve upon members of the Association resident in Montreal, and we are pleased to learn that the arrangements are already engaging their attention. There is much to be done, and it is none too early to begin the work. If every member will give what assistance he can, the convention in Montreal should equal if not surpass any previous one.

A correspondent writes making enquiry regarding removable fire-door arches. We are not aware of any firm keeping these in stock for sale, but they can be readily enough made. One form is made by bending flat bar iron into an arch with the ends of the bars turned in to point to the center from which the arch is drawn. Into these bars build a brick arch. The arch bars form the top of the arch, and hold the bricks together, so that the whole mass may be lifted into place. When in position, the iron in not exposed to the heat as the bricks are between it and the furnace. Another method is to make a frame of piping, with connections into the boiler, and cover the pipes with thin fire brick and fire clay. Sometimes the feed water is made to pass through this piping, but if the water makes much scale it will choke up with deposit. If any of our readers have met with any other kind of fire door arch for boilers we shall be pleased to hear about them.

AN electric launch from the World's Fair has been introduced upon the Grand Canal at Venice and the trial has been pronounced successful. This time it cannot well be said that progress is not an improvement for, apart from the fact that the graceful movements of the electric launch will be more in harmony with the style of Venice than were the steamboats which are to be displaced, the damage to the marbles of the palaces from the contamination of the atmosphere by smoke, which Ruskin deplored, will be removed. The silent progress of the electric launches is also in harmony with the quiet of a city in which there is neither wheel or hoop and in which the noise of the little steamboats was an intrusion. But, and here there is another side to the question, the steamboats on account of their necessarily large size, were confined to the Grand Canal (where in truth they have been a great comfort) but a storage battery electric launch can be built small enough to navigate the small canals, and the gondola is in danger. The gondola amply exhibited its inferiority at the World's Fair where it plied over the same ground as the electric launches. But this very inferiority may save it. To those who had seen the gondola at home and watched constantly with increasing delight the ease and rapidity with which it threads its way through the traffic on the narrow canals, the lumbering appearance it presented on the lagoons of the World's Fair was a surprise and disappointment. The apparent speed of the gondola at home turns out to be only relative to the obstruction it meets.

THE General Electric Company of the U. S. occupies such a prominent place in the electrical world, and is involved in so many electrical interests, that the condition of its affairs affects in some measure the whole electrical business of the United States, and reacts upon us in Canada. The heavy losses this company was known to have sustained during the past year, caused its annual statement to be looked for with more than ordinary interest. This was presented at the meeting of the stockholders held at Schenectady, on April 2nd. With a capital of $35,000,000 and a bonded debt of $10,000,000, the surplus of $1,024,954.59 shown by last year's balance sheet is this year converted into a deficit of $12,454,967.42. This tremendous shrinkage of thirteen and a half millions is in a measure offset by the very great improvement in the condition of its floating debt, the unwieldy dimensions of which were the cause of its embarrassment last summer. On July 31st, 1893, more than a month after its troubles began its direct obligations from notes and accounts payable were $5,340,000 with indirect obligations in addition, from customers' paper discounted under endorsement, amounting to $3,394,000. At the date of the report, April 2nd, 1894, these figures had been reduced to about $350,000 direct obligations and about $750,000 customers' paper under discount. The forced sale of securities to provide cash to meet the floating indebtedness accounts for a great part of the shrinkage of the assets, but large amounts are also written off the inventory of stock, and sweeping reductions are made in the valuation of securities owned by the company. The report in many ways shows a much healthier condition than last year. The principal adverse criticisms of the report are directed at the large figure ($8,159,264.92, the same as last year) carried as an asset on account of Patents and Franchises, but the reductions in the valuation of the other assets have been so sweeping and apparently so uncompromising, that the directors may perhaps be permitted a lingering hope that values will improve with the times, and be excused if they have given the Patents and Franchises item the benefit of a doubt. The offices of all departments have been concentrated at the principal factory at Schenectady. This is a very wise move which should result in much economy and greatly increased efficiency in handling the business of the company.

THE bill introduced into the Ontario Legislature by Mr. Tait on behalf of the Ontario Association of Engineers did not pass. It was defeated on the second reading by a vote of 24 to 12. Mr. Balfour objected to the bill because of its being a piece of special legislation for a particular class. This seems to have been a strong argument against the bill in the form in which it appeared. Yet class legislation is not new ; the education and and work of lawyers, doctors, teachers, druggists, and others are provided for by class legislation ; why should engineers be treated differently? When the bill to provide for the education and work of engineers is as carefully prepared and has in it all the necessary guards for the protection of the individual rights, both of the engineers and the public, no doubt the cry of class legislation will have lost its force. Some thought the bill was too one-sided and would not have had the effect expected by its promoters. The interest of both employer and employed must be considered and properly guarded, else such a measure, even if it did become law, would fail in being beneficial to either party. We think that, in this young country, it would be wisdom to follow the lead of the older lands, especially of our own mother country, where experience has been gained during so many years. The present law in Britain compels owners of steam boilers to have them examined by a competent person. Every accident, however trifling in itself, if of the nature of an explosion, or bust, which occurs to any boiler or its connection, has to be reported to the government. An investigation is held by a court of enquiry, something like a coroner's inquest, except that the government supplies competent men to form the court, and a lawyer to prosecute investigation. The cause of the accident is traced, and if the fault is due to the maker, or seller, or user, or attendant of the boiler, the offender is punished. This act has given great satisfaction during more than ten years, and has had the effect of making boiler owners more careful in regard to the purchase of boilers, and as to the men employed to take care of them. In case of accident the owner has to prove that the men whom he employed were competent, and as every trifling accident, such as the blowing out of a joint, or the breaking of a blow-off cock, has to be reported, it makes owners careful that every little detail shall be properly attended to. As no one can use a steam boiler without in some degree causing risk of injury to other people and other peoples' property, this British Act seems a most reasonable way of compelling boiler users to take care of them.

The construction of the Hamilton, Grimsby and Beamsville Electric Railway is being proceeded with, some forty men and ten teams being engaged on the grading, and a dozen line men and diggers on the overhead construction. The number of men is being increased, and every effort made under the direction of Mr. F. E. Handy, superintendent of the road, to complete construction by the 1st of July. The power station at Stony Creek is ready for the roof, and the boilers will be in position in a few days. A large tank has been made, 130 by 80 feet, 14 feet deep, for the storage of water. The chimney will be 100 feet high, stone foundation, set on concrete. The company have had some little difficulty within the last few days with the township council of Salt Fleet, over the question of right of way, but the matter is in a fair way to be amicably adjusted.

TAXATION OF ELECTRIC AND GAS STREET PLANT.

MR. O'Connor's bill, now pending in the Ontario Legislature, to declare the mains and general plant of gas and electric companies non-assessable for municipal taxation, is meeting with considerable opposition from some quarters. The reasons alleged for this opposition are briefly, that the lighting companies are rich and can stand the tax, that to declare their plant non-assessable would be to "rob" the municipal treasuries, and further, that as a broad principle of plain justice, investments in lighting plants should be taxed the same as investments in buildings or merchandise. This last objection is simply begging the question. Lord Palmerston once enunciated a similar broad principle, when he said in his jaunty off-hand manner, that he did not see why spirits should not be sold freely like molasses by every grocer. He ignored the very essential point that spirits are not like molasses. In the case of Mr. O'Connor's bill the point is, that investments in gas and electric plants are not the same as investments in buildings or merchandise, and the question is, whether the special circumstances under which they have been developed are not such as to make it wise for the legislature to intervene, to insure that these investments in plant should continue exempt from municipal taxation. We say continue exempt, for it must be borne in mind that it is the taxation which is new, not the exemption.

The County Court judge's decision last year, on the assessment then for the first time made on the distributing mains of the Toronto companies was, that the municipalities have the legal right to assess. But this right had not been previously exercised, except possibly in a few instances. The effect of Mr. O'Connor's bill in general, is therefore not to "rob" the municipal treasuries of any benefit they have hitherto derived from this source; it does not cut off a portion of their revenues and hand it back as a bonus to a few taxpayers who have hitherto managed to carry on their business and pay taxes without the aid of a bonus; it simply deprives the municipalities of a right, which they have hitherto wisely refrained from exercising, of imposing what would practically be a new tax upon a class of industries which are perhaps more than any other of general benefit to the communities in which they exist: and a tax which in probably the majority of cases of the small towns would mean at present the difference between a profit and a loss to the enterprises concerned. Now the opponents of the bill do not propose that the electric lighting companies should carry on business at a loss, or even at a smaller profit than they could obtain with much less risk by investment in mortgage; and in order to live the companies must in some way recoup themselves of the amount of the tax, to make good their diminished or vanished profits. They cannot reduce their expenses and there is nothing left to do but to increase their rates. But in the very great majority of cases, their largest—by far their largest—customers are the municipalities themselves, who at increased rates would take out of their treasury with one hand nearly as much as they put into it with the other. The difference, which the municipality nets, represents the increased cost to the private users of light, who may be presumed to be the most active, enterprising and desirable class of citizens, and whose superior merit this tax would reward and encourage by what is practically an extra assessment; not to pay the lighting company inordinate profits, but that the lighting company may be enabled to live and furnish the public lighting; in other words, an extra assessment levied only upon their lights, in order that their less enterprising fellow citizens may pay less than their proportionate share of the general town lighting.

Where the rates for town lights are fixed for a term of years by a contract made at a time when the plant was not taxed, the imposition of a tax now without modification of the contract rate would—even if legal—constitute an act of injustice which in the healthy and intelligent public life of our small towns we do not think would be permitted. In our larger towns not only is the municipal government less in touch with public feeling, but unfortunately the latter is less active. The companies are larger, their dividend rate is good, and the injustice of the added taxation is less obvious, as its effects are more far reaching. Public feeling cannot or will not protect them and dividends must be reduced to pay the tax or it must be paid out of the accumulated reserve—where there is any. In either case the market value of the stock falls correspondingly, and the shrinkage is practically a forced subscription from those who are stockholders at that time. Now who are these stockholders who constitute the "rich corporation" and "can stand it?" A glance at the stock exchange list will show that the public thinks well of these stocks as an investment, that they are quoted at a high premium, and that gas, telephone and electric light stocks are changing hands daily at prices which yield a return to the purchasers of only 4½ to 5½ per cent. The original stockholders whose courage launched the enterprise, and whose care and skill guided it to the successful issue they had foreseen for it, have reaped some of the reward due to their daring and ability, and have sold all or a portion of their stock at a premium. The immediate or ultimate purchaser is generally the man who by steady work in his business or profession makes both ends more than meet. He has a yearly surplus to invest. He is pre-eminently a sensible man, and he knows that for him to put his money into any new venture promising large returns, but to which he himself could give no attention, would be culpable folly. He is content to put up with a low rate of interest in return for investments which are not likely to be much affected by hard times, and which are always readily saleable. At his death they form part of the provision he leaves for his wife and family. In his investments he plays a doubly useful part in the community by discouraging the promoter who is so ready to be venturesome with other people's money, and by encouraging the sound enterprise of the business man who develops with his own money a new source of wealth. He pays the latter the premium successfully earned, and liberates his augmented capital to be employed with proved skill and riper experience in new enterprises which develop the latent resources of the country and add permanently to the wealth of the nation.

Investors of this class are obscure but exceedingly useful, and any action which would create in them a feeling of distrust would be, to say the least, very inexpedient. They are innocent holders of the securities, and as such their just interests should be jealously safeguarded. These men, their widows and unmarried daughters, are ultimately the principal owners of gas and electric companies in the larger towns, and the result of Mr. O'Connor's bill in the larger towns is not to "rob" the municipal treasuries, but to prevent the municipalities from confiscating at a blow a portion of these men's savings, on the specious plea of levying a tax upon their earnings.

To sum up, merchandise may seek a market anywhere; buildings though confined to one locality may be put to many uses; but lighting plants can be used for only one purpose and are narrowly restricted to one locality in seeking customers, and in many cases are almost confined to one customer only. The investments were made and the business developed under conditions which the opponents of this bill desire to retain the right to alter. Where the enterprises have proved successful they have largely passed out of the hands of their originators into those of many small owners, who receive a low rate of interest on their investment, and part of whose capital would be wiped out to capitalize the annual payment of the tax in the large towns, whilst in the smaller towns the benefit to the municipal treasury would be largely illusory. It is not sufficient answer to say that this taxation would be legal. The question is, is it expedient? Is it wise? Is it just? In passing this bill the legislature will be exercising one of its most important functions, that of righting by new enactments the wrongs which result from the application of old laws to new conditions. Mr. O'Connor's bill has passed the committee, and we trust that it will be equally successful in passing the House, which by enacting this bill will show that it truly represents the people of the province, whose approval of the principle of the bill is shown by the good sense with which the small towns and villages have abstained from exacting those legal rights which this bill now seeks to abolish.

Since the above was written the friends of the measure decided upon its withdrawal owing to the increased opposition manifested by a majority of the members of the House. The question of the correctness or otherwise of Judge McDougall's decision will now presumably have to be decided in the Superior Courts.

Arrangements are being made to install a new incandescent lighting plant at Orillia, Ont.

THE BRITISH BOILER EXPLOSIONS ACTS.

In Britain there are acts of Parliament relating to the use of steam boilers known as The Boiler Explosions Acts, 1882 and 1890. Under these Acts the owners of steam boilers must report every accident of the nature of an explosion within 24 hours of its occurrence. From the last report to the Secretary of the Board of Trade by the Solicitor having charge of the workings of these Acts, we learn that the year ending June 30th, 1893, there were 72 investigations held. Some of these were merely preliminary inquiries, but 26 were formal investigations. Of the 72 accidents, 32 were from deterioration, or corrosion or some part of the apparatus having become defective. 23 were from ignorance or carelessness on the part of the attendant, 8 were from defects in design or workmanship, and in 9 cases the causes could not be definitely placed under any of these divisions.

It is interesting to note that the English law does not compel a boiler owner to place his boiler under the charge of a man holding any kind of a certificate, but the law holds the owner responsible, and in event of an accident he must prove that he employed a "competent" man. It goes further, and if at any of these formal investigations, it is proved that the accident was due to negligence on the part of anyone, whether attendant or owner, maker or seller of the boiler or its attachments, the law is strong enough to reach him, and inflict some form of punishment.

Here are samples from the report before us. No. 582—Manufacturing engineers blamed for reckless conduct, and to pay £20 costs; No. 590.—Managing director blamed for neglect and ordered to pay £40, costs; No. 608.—Owner blamed for not employing a competent person and ordered to pay £85, costs; No. 623.—Owner blamed for want of proper supervision, and attendant blamed for neglect. Owner to pay £20, and attendant £5, costs; No.651.—Owner held responsible for negligence of his engineer, and a blacksmith who ignorantly advised owner as to the working pressure was blamed. Owner to pay 20 shillings and the blacksmith £20, costs.

We commend this to all parties interested in steam boilers. The acts have been in force a number of years, and have given good satisfaction. A similar act in Canada would do much to improve the steam appliances, and would make owners careful as to what kind of a man they employed.

The investigations refer not merely to what are usually called boiler explosions, but cover accidents to any connection of the boiler which is under steam pressure. The breaking of a steam pipe, the rupture of a tube or the bursting of a blow-off pipe must be reported, hence owners are much more careful.

Some of the accidents investigated were of boilers which were insured. The report says: "As regards the Boiler Insurance Companies, no cause has arisen in connection with the working of the Acts which shows any serious neglect on the part of their inspectors, nor has any blame been attached to them by the Court in any formal inspection which has been held during the year."

NOTES FOR ENGINEERS.

A CHAIN is no stronger than its weakest link, and a steam boiler may have some one spot weaker than other parts, and in estimating the safe pressure, the strength of this weaker part should be taken into account.

Factors of safety, as they are called by mathematicians, are used as a means of making allowance for unseen or suspected or possible weaknesses. For example, a boiler shell is made of plates the strength of which is known, but the riveted joint is weaker than the plate, and the fit of the rivets in the holes may not be perfect, hence some allowance must be made for unknown imperfections.

It is common to make a calculation of the amount of metal left after the rivet holes are cut, and of the metal in the rivets, and determine the supposed amount necessary to break the plate. A well designed, double riveted joint should, however, give 70% or nearly three fourths the strength of the plate.

Stays, and especially screwed stays, may corrode and soon become much weaker.

It is common to calculate the strength of the riveted joint and divide by five as a factor of safety, so that the working pressure is only one-fifth that required to rupture the joint. The factor of safety used for stays and parts liable to be corroded is larger, often as high as ten, so that when new these parts are much stronger than the plate joint.

In connection with steam boilers there is another way of looking at the need for using a factor of safety. The rates still in use were adopted years ago when the quality of the metal was much more uncertain than it is now, and when the methods of working the metal were more likely to injure its strength than is the case with those now used by first-class makers. We have now a better guarantee that the finished boiler will really be of the strength intended. If this be so, then that part of the factor of safety which was used to allow for uncertainty of the strength and workmanship is not now so necessary.

Boilers made of steel by makers having good appliances are now in use with a pressure where the factor of safety is four, and possibly even this may in time be reduced.

We are not arguing in favor of engineers taking greater risks in using steam boilers, but we are arguing that boilers which have been made in the most skillful way and of the best material should not be rated as being only equal to those made of poorer material and in a less skillful manner.

HOISTING MACHINERY.

THERE is probably no non-productive machine about a shop that earns as much, to put the matter paradoxically, writes J. H. Allen in the Illustrated Carpenter and Builder, as the crane. When we see a group of men working until every muscle is strained to the very limit of its endurance in attempting to lift a heavy casting into position on a lathe or planer, all in default of a suitable hand hoist wherewith one man could do the work in one-tenth the time with one-thousandth the actual exertion, we are disposed to look upon the proprietor of that shop as being an old fogey who is so far behind the times that it is a hopeless task for him to so much as make the attempt to catch up.

There is no shop so small, no business so poor, that should not have its complement of cranes and hoists. First of all there should be the self-sustaining hoist with a capacity equal to the heaviest of the probable requirements. When we come to the cranes they may be a simple ring in the ceiling into which the hoist is to be hooked, or the elaborate travelling crane. But for the small shop there are a multitude of simple designs that can be made at a low cost and which will serve their purposes most admirably. The most common is the straight bar, slightly curved up at the outer end, and suspended by a stay to the post, about which it swings. Old railroad iron seems to be the most suitable material for such a swinging jib. It has the advantage over the plain flat bar, in that the head and flange give it a lateral stiffness, so that it is not likely to buckle, and the unnecessary metal which it contains receives a compensation in the very low price at which it can be bought. Such a jib can be hung to a post or to the wall; the only care that need be taken is that the horizontal pull should be carefully calculated, so that it may not exceed the resistance of the wall and pull it down. It seems superfluous to call to the attention of our readers that the greater the distance between the point of attachment of the upper end of the stay and the heel of the jib, the less will be the horizontal pull on the wall.

Sometimes, however, there is no post or pillar near at hand, and the jib must be held by its own swinging post. Belts and machines may be thickly strewn around, and yet when the trolley cannot be made to serve, the swinging jib crane can usually be worked. It goes without saying that there must be some space in the floor and the ceiling above for stepping and fastening the post. So we first locate this, and then proceed to put in the longest jib that will swing over the desired arc and clear the belts. Of course, this is not long enough to pick up our work and put it where we want it; so we devise an extension jib. This can be done by building our main jib in two parts, and carrying a set of rolls flush with the bottom and top, and running our extension between the two parts, and taking the upward and downward thrusts on the rollers. If they are well put up and kept level, one will be surprised at the ease with which the heavily-loaded extension can be worked in and out, and the load swung in and around the belts, that at first sight would seem to preclude all possibility of the use of a crane.

When we pass beyond the domain of the simpler tools, it is doubtful if it will pay any proprietor to construct his own hoisting tools, unless he does it to keep his men busy in a dull season and to avoid breaking into the efficiency of his working force.

If the need arises for a peculiar construction of crane for doing a special piece of work, it is probable that someone has had the same need before, and that the shop of some crane builder will have the pattern to furnish just exactly what you want. The height of hoist, the weight to be hoisted, and the power available can all be combined, and the result will be a tool especially suited to your wants.

The first travelling crane with which we had to do was one of our own designing, and of home manufacture. Its capacity was ten tons, and its span 40 ft. A railroad shop received the benefit. It was operated by hand, it moved slowly, and the general manager thought it no good. But when he learned that with this infant the time required for putting a cylinder on the planer was dropped from an hour and a half with four men to five minutes with two he looked interested. When the time of taking an engine cab from its place and putting it on the painting scaffold was cut down from three hours to twenty minutes, he ceased to gibe at our little tool made of four by six pine sticks; and when he saw a boiler come travelling down the shop far above the impediments of the floor, he owned the tool to be a handy one, and before it had been in the shop a year, he OK'd a requisition for a power tool that would lift thirty tons and cost a very pretty penny. Such is the educational influence of small things.

A by-law will shortly be submitted to the ratepayers of Hamilton, Ont., to authorize the expenditure of $100,000 for the purchase of an electric plant for lighting the streets under the control of the city.

A new power station for the Toronto Electric Railway Co. is under construction and being rapidly pushed to completion. Foundations have been completed for the two large Siemens-Halske generators which are to be installed. The chimney stack for this station will be 250 feet in height, and will have a foundation resting upon solid rock, 15 feet beneath the surface of the ground, and 40 feet square.

DEVELOPMENT OF SWITCHBOARDS FOR MODERN CENTRAL STATIONS.

By A. B. Herrick*

In the designing of central stations a great deal of attention has been given by electrical engineers to the subject of switchboards. Too much attention cannot be well directed to this branch, both in regard to the concentration and the consequent reduction in the space which it occupies, which leads to reduction in first cost. Care also has to be given in combining and placing the apparatus in such a way that the cost of attendance will be as small as possible, besides always having in view methods to give the greatest flexibility possible to the system.

In regard to the location of the board, the universal modern practice, both abroad and at home, is to place the switchboard in a gallery or in some elevated position where the attendant has full observation of the operation of the different units under his charge, and can judge, in the case of any peculiar behaviour of the generators, the proper remedy to be applied, and be prepared to take the unit off the circuit if necessary. There is another marked general tendency in switchboard construction—that is, to make the whole structure absolutely fire-proof.

In the case of low equal potential distributing systems, especially in the three-wire feeder and main system, the switchboard arrangements bear a very important relation to the satisfactory operation of the system. The advance in this line has been so marked in the last few years that it will repay us to review the past history of the low potential systems of distribution in a few words, and to seek clearly the causes that have made it necessary to introduce the modern novel methods to increase the economy of operation in production and an effective distribution of the current.

In order to distribute the current at a high economy by means of the feeder and main system, it is necessary to place the station at the average centre of distribution. This simple proposition is complicated by the fact that a city is divided into business and residential portions, each having different periods of maximum demands on the station, and as these districts are not generally symmetrically located as regards the station, the centre of maximum efficiency of distribution travels over considerable distances during the day.

Different methods have been adopted in the past in order that the station may deliver its current to the mains at an equal potential ; in other words, artificial means have to be used to bring the varying centre of the distribution to the station.

The first means resorted to was to introduce into various feeders an artificial adjustable resistance, to compensate for the unequal losses occurring in the feeders This method has become obsolete in good practice. The immediate remedy was to put in more copper in the form of new feeders and larger mains, but as the low potential systems have been expanding over larger areas, to include a greater number of customers, it has again become necessary to deliver current at the station ends of these feeders at different potentials to compensate for the unequal loading of the system. This was originally effected by running the dynamos at different potentials, feeding into independent busses, the feeders being so arranged that they could be thrown on any of these busses and supplied with current at the proper potential, to deliver their current to the mains at a uniform potential. When the units in the station were small, they could be divided up on the different busses with comparatively high economy, but as central station business has expanded units had to be adopted both for economy and first cost per kilowatt, higher economy in current production, and to obtain a larger kilowatt output per square foot floor space. With the introduction of these large units, two conditions confront the engineer ; one—it was necessary to run the unit at nearly the maximum output, in order to get the maximum efficiency of the generators and engines combined ; and the other—to deliver this current at two or more potentials to different groups of feeders.

To follow the ordinary load diagram of a station, beginning at the lowest point, it is very rarely required to produce the current at more than one potential. Here all the feeders may be thrown on one bus bar, or the bus bars may be tied together. As the load rises, certain feeders will become more heavily loaded, and they will have to be supplied with a current of high potential, but to run a large unit on this potential bus, where the load it has to carry is a small part of its total capacity, it would be an uneconomical method of producing this current, as the unit under these conditions is working disadvantageously both as regards expansion of steam in the engine the friction field and armature losses. Several different methods are now used to effect a higher economy in the delivery of the current to the busses. Mr. Barstow, general manager of the Brooklyn Illuminating Company, has devised the well known "booster" system. This method works out very well where three potentials are required. In the three-wire system two "boosters" are required for each potential, and it is the usual practice to couple these "boosters" together, making one continuous line of shafting, to which is also coupled a motor for the purpose of keeping the "boosters" up to full speed and making good the losses due to transformation and unequal loading of the high and low busses. The losses inherent in the "booster" system are those occurring from friction, armature losses, and field excitation.

A method has been devised by which to obviate these losses: a dynamo can be used to produce on a single armature two or more potentials. Where the difference of potential is small, and where the load on the high and low busses does not fluctuate very rapidly, a smooth body multipolar direct driven dynamo can be used ; but where the differences of potential and load are extreme, a special dynamo is applied and different parts of the armature run at different potentials and on two or more separate busses. Its action will be similar in every respect to that of two or more independent dynamos. The different parts of the armature giving different potentials are controlled by separate regulators and the load on these separate busses carried to a point at which it will be economical to operate a separate unit. Then this special dynamo can be connected to any one of the busses in the same manner as any other unit in the station. The different parts of the armature are brought to one potential and thrown in on any required bus in the same manner as in the operation of three separate dynamos. In this way some of the losses inherent in the booster method are obviated, and full economy of the supplementary bus output is always obtained; and the full load of these auxiliary busses being carried by the one dynamo brings the output of this dynamo up to an efficient point as regards the operation of the engine and dynamo.

In the introduction of the modern multipolar machine great attention was necessary in the field circuit arrangement, and the proper method of exciting dynamos is still an open topic. Two methods are commonly used, each having its own peculiar advantages and especially applicable to different systems—the self-exciting, bus exciting. The advantages and disadvantages of these methods are as follows:

In the self-exciting method the field terminals are connected to the brushes. The advantage of this is that the field gradually dies away as the dynamo slows downs, and when the dynamo has stopped the field has entirely disappeared. The danger of a sudden discharge of the field, which would submit the field winding to a strain on account of the high potential induced, or breaking down the armature, is thus avoided. The disadvantages of this method are: 1st, the slowness with which the dynamo builds up its own field, as the dynamo frequently runs at full speed for some time before it develops sufficient electromotive force to be connected to the system ; 2d, the possibility that the field may build up reversed. This may be caused by the sudden discharge of the field by a short circuit, or even by proximity to another dynamo.

In the bus-exciting method the fields are connected to the station mains or busses. The advantage of this method is that the field is instantly made and the dynamo connected into the system as soon as it is up to speed. The polarity of the field is always the same and cannot be reversed. In bus-exciting of large multipolar dynamos the taking of the field off the bus introduces into a system of low potential, a high potential discharge, which submits the field insulation to a strain which can be avoided in several ways. One method is by having a special switch, which, before severing the fields from the bus, connects the fields in such a way that it is divided into two halves, the electro-motive forces of discharge are opposed against each other and consequently die away without having any effect.

The disadvantages of the bus-exciting method are : 1st, that in case the system is short circuited sufficient potential can not be generated to burn out the short circuit ; 2d, if the dynamo is operated on a different bus from which it is excited, full output of the machine cannot be obtained in case the exciting potential is lower than its working potential.

It will be noticed that all conducting parts and switch contacts are made more massive than in the old type appliances. The economy of this is very apparent ; for instance, if a thousand ampere switch were used which had an average elevation of temperature of 20 degees Fahr. above the average air temperature of the station, this would mean an average loss of 72.2 watts. And with electrical horse power delivered at $60.00 per year the energy expended in heating this switch would cost nearly $6.00 per year. From this it is evident that a switch possessing more material and contact surface would be a very economical investment. These points of sufficient carrying capacity unfortunately do not become evident until the station becomes fully loaded.

If any part of the switchboard passes an average of 20 degs. Fahr. above the surrounding air, the high water mark for economy has been passed in the design of this board, and it is unprofitable to pass the current through devices whose temperature averages more than 20 degs. Fahr. In this case the manufactured product of the station is uselessly wasted in its transmission. It should be utilized for earning dividends by passing it through the meter of the consumer instead of wasting it in the station.

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*Abstract of paper read before the National Electric Light Association Convention, Washington, D. C., February 27, 28, and March 1, 1894.

Mr. John W. Anderson of North Toronto, a large shareholder in the Metropolitan Electric Railway Co., has caused a writ to be issued to restrain the directors from selling the franchise to the Toronto Railway Company.

The Ontario Legislature has passed a bill authorizing the amalgamation of the City and Suburban Electric Railway and the Davenport Street Railway Co. The company will henceforth be known as the Toronto Suburban Railway Company.

SOME TROUBLES: LOCATING AND OVERCOMING THEM.

NEARLY all trouble in the electric lighting plant is due to neglect, or a lack of information regarding the principles and details of the machinery used. In a number of plants where alternating machinery is employed, trouble has been experienced on account of the exciters running hot and the machines not working up to their full capacity. In one particular case of this kind it was noticed that on some evenings the exciter would run cool and the alternator work up to its full capacity and as nicely as could be expected, while on the next evening, probably, the exciter would run very hot and it would be necessary to throw out all the resistance and even then the alternator could not carry the load up to full voltage. As this trouble was not experienced each evening, the cause was a mystery and for a long while baffled those in charge. At last, someone with a more extensive knowledge of the principles, being present at the time the machines were shut down, noticed that when the exciter current was cut off it was done by opening a switch in the exciter circuit.

Opening the switch suddenly in this way produced a strong extra current in the field coils of the machines which, being in a direction opposite to that of the usual excitation, changed the polarity of the field magnets so that the exciter current worked in opposition to that of the auxiliary current from the self-exciting alternator.

In these alternators a certain portion of the current is taken from a commutator, thus straightening it, and making it direct so that it can be used for exciting the field ; but it is not enough to excite them to the extent required and neither is it intended to do so. The exciter current is used to produce a certain strength of field to excite the machine primarily and also increases the strength of field to overcome any drop of potential that may occur on the lines ; and when the polarity of the exciter is reversed the machines do not work together in the way they should.

To overcome the above defect it was only necessary that the current from the exciter should be allowed to die away gradually, thus preserving the original polarity of the field magnet. This same difficulty has occurred in a number of lighting stations and there are, no doubt, some stations at the present time where the operatives are struggling with the same annoyance.

There is one difficulty that frequently occurs in the handling of T. H. arc light machines which results in frequent flashing at the commutator. This flashing becomes persistent and is most annoying, as everything about the machine and circuits will appear to be all right so far as the ordinary tests show.

The machine will start up all right and run nicely for a short time when, in some cases, the commutator will begin to cut and the machine begin to flash and will continue to do so until shut down at the end of the run. One cause of such difficulty, which is of frequent occurrence and is often overlooked, is that the screens on the air blower are allowed to become dirty, thus closing the apertures so that an insufficient supply of air is obtained. not enough to blow out the arc which forms between the commutator segments—this is the cause of the flashing, by the current bridging over from one segment to another because there is not sufficient blast of air.

Another difficulty which occurs with the same device is that the oil holes sometimes become closed and the friction in the blower heats it to such an extent that warm air and vapor is blown on to the commutator. The warm air is a sufficient conductor of electricity so that it provides an opportunity for the arc to form, which it does immediately, and the consequence is a flash.

A commutator seldom gets hot unless the shaft becomes over warm and this is generally heated from the bearings when such trouble occurs. When the commutator becomes hot it will vaporize, to a certain extent, any oil, shellac, etc., that may have been used in, or on, the commutator. This warm vapor, being a fair conductor, allows the current to jump across the insulation, forming an arc which often extends around the commutator, producing a flash and putting out the lamps for an instant.

Flashing occurs much more frequently on arc than on incandescent machines, for the reason that the potentials carried are much higher. A defect that will cause flashing on an arc machine would produce nothing noticeable in the workings of a low tension machine, although the same neglect has allowed parts to become dirty or bearings to become warmer than they should.

Some dynamo attendants make a practice when feeling of bearings to ascertain whether they are warm, of placing their fingers on the cap of the bearings, instead of on the bottom as they should. A dynamo shaft works altogether on the lower bearing and sometimes the cap is set on liners which are non-conductors of heat. In such case the shaft and lower bearing might become quite warm without the cap showing any noticeable rise in temperature. For this reason it is always advisable that the attendant should always feel of the lower bearings to ascertain if they are becoming warm ; and many a superintendent or electrician would save himself considerable annoyance with flashing machines if he will direct the attendants to look particularly to this point.

Another cause of flashing, on one particular type of arc machine, is too great an accumulation of oil on the commutator, or rather on the lower brushes, for this is where it gathers, until the amount is sufficient to fly off in large drops. An accumulation of oil at such point will, by bridging over the insulation or air space, cause flashing as soon as the oil becomes warm. This it will do because the oil is interposed between the brush and commutator segments and by reducing the electric conductivity cause heating. This can only occur from oversight or neglect and can be easily removed when noticed. Verily, cleanliness is next to Godliness in the electric light or power plant.

FUEL ECONOMY IN ELECTRIC STATIONS.

At the recent convention of the National Electric Light Association, a committee presented a report upon the coal consumption of electric stations, which seems to indicate that the average of electric stations are wasteful in the use of fuel, and that there is an immense opportunity for improvement. The committee states :

We are requested to furnish this convention with the facts regarding the amount of coal used in actual practice to produce a given quantity of electricity. The information was obtained by correspondence, and furnished the committee in amperes, volts and hours on each circuit, and the amount of coal used covering this period, including that used for banking fires, etc. The aggregate electrical output for twenty-four hours was then calculated and compared with the total amount of fuel used, giving the watt hours per pound of coal. All improbable and apparently erroneous reports were discarded, and the tabulated statement herewith comprises intelligent replies from a large number of electric stations, including many of the leading corporations. The great saving in operating in large units and running continuously is plainly shown by the report, which shows 208 watt hours per pound of hard screenings where about 8,000,000 watts were generated, running full twenty-four hours, as against the report, which claims only thirty watt hours per pound of soft coal, the total output being less than 60,000 watts and the service being furnished only seven hours. The best results do not compare favorably with the results secured in generating power for manufacturing purposes.

In order to facilitate this comparison we have prepared a table based on 90 per cent. mechanical efficiency in the engine, and the same efficiency in the dynamo.

$$\text{Then } \frac{746 \times .90 \times .90}{\text{coal per hour.}} = \text{watt hrs. per lb. of coal.}$$

Coal per hour per I. H. P.	Watt hours per lb. of coal.
1.5 pounds should produce	402.84
2 " " "	302.13
3 " " "	201.42
4 " " "	151.06
5 " " "	120.85
6 " " "	100.71
7 " " "	86.32
8 " " "	75.53
9 " " "	67.14
10 " " "	60.43
11 " " "	54.93
12 " " "	50.35
15 " " "	40.28
18 " " "	33.57
20 " " "	30.22

From this estimate of engine and dynamo loss, 1½ pounds of coal should produce 402.24 watt hours. We have a report from the Chelsea jute mills, of Brooklyn, N. Y., covering a period of six days, where an average of 653.3 indicated horse power was developed from a coal consumption of 1.482 pounds per indicated horse power per hour, the load varying from 495.21 to 764.96 horse power.

This equipment consists of Corliss compound condensing engines and vertical tubular boilers. The plant was in operation ten hours each day. The figures given cover the whole amount of fuel used, including banking, etc. The fuel used was George's Creek bituminous coal.

If our percentage of efficiency is correct, and if we could have a fairly uniform electrical output this plant ought to produce over 400 watt hours, or double that of the most favorable report given us, more than double that of the next best report, thirteen times the efficiency of the plant making the lowest report, and between four and five times the average efficiency of the whole report.

No attempt has been made in this report to classify equipments, as was originally intended, but with the information here furnished as a basis the work can be readily classified, additional information secured, and the original scheme of establishing an average basis of efficiency for the several lines of equipment can be carried out.

The correspondence shows a marked interest in the work, and many returns were accompanied by a request for information showing how their report compared with others. We believe the tendency of the work is to encourage more careful records, which in turn assist in locating and eliminating losses, and we hope future reports by this committee will show a much better average than 88.4 watt hours for one pound of coal.

After a considerable amount of discussion, the Ontario Legislature refused to grant incorporation to the Toronto and Richmond Hill Electric Railway Company.

PERSONAL.

Mr. M. W. Corbitt, who is well-known from his long connection with the electrical trade, has been appointed representative of the Montreal Electric Co.

Mr. L. W. Crannell has resigned his position with the Royal Electric Co. and accepted that of general agent for C. W. Henderson, electrical contractor and manufacturer, of Montreal.

Mr. D. A. Starr, who has for many years been connected with the Royal Electric Co. of Montreal, has lately severed his connection with that concern, and has opened an office as consulting electrical engineer, in the Board of Trade building, Montreal.

Mr. G. R. Long, of Brooklyn, N. Y., has been appointed mechanical superintendent for T. W. Ness & Co. of Montreal, and has charge of the factory of this company. Mr. Long is extremely well qualified for the position, having had an extensive experience in the manufacture of electrical apparatus.

Mr. Ross McKenzie has assumed the duties of his new position as manager of the Niagara Falls Park & River Railway. Mr. McKenzie is very familiar with railway work, having served for ten years past as assisant superintendent of the eastern division of the Canadian Pacific Railway.

Mr. Sulby of the Crompton Howall Electric Storage Battery Co., paid a flying visit to Montreal the other day to witness the successful starting of the battery plant in the Royal Victoria Hospital which has been installed by the Crompton Howall Co., thus making the third large storage plant put in by them in Montreal.

Mr. W. A. Grant, who so successfully managed the Niagara Falls Park and River Railway Company during the first year of the operation of the road, has retired from the management, and has been succeeded by Mr. Ross McKenzie of Montreal. Mr. Grant again assumes a position with the Canadian Pacific Railway at Montreal. Prior to his departure for that city, he was the recipient, at the hands of the employees of the road, of a handsome gold watch, chain and locket.

SPARKS.

The assignment is reported of Mr. C. R. Ernst, electrician, New Hamburg, Ont.

A 1000 light Westinghouse plant is being installed by the Windsor, N. S., Electric Co.

Mr. W. H. Baker, electrician, of London, Ont., is reported to have abandoned his estate.

Mr. A. Ramage, Chesley, Ont., has recently installed a 600 light Westinghouse alternating plant.

An electric light plant has recently been installed by the Reliance Electric Manufacturing Co., at Cayuga.

Mr. W. C. Freydenburg is interested in securing the installation of an electric light plant at Westport, Ont.

A 500 light incandescent light system is to be installed at Mitchell, Ont., by the Royal Electric Co., of Montreal.

The Fenelon Falls Electric Light Co., of Fenelon Falls, Ont., has just been incorporated with a capital stock of $3,000.

Mr. W. C. Price, left Toronto a few days ago for Honolulu, for the purpose of introducing Canadian electrical machinery.

The report of the city engineer of Quebec show that the city is at present lighted by 300 arc lights, at a cost of $80 per lamp per year.

Mr. H. N. Rorison has purchased the electric light plant at Moose Jaw, N W. T., and is making additions and improvements thereto.

It is said to be the intention of the Nanaimo, B. C., Electric Light Co., to discard their present plant and install an entirely new system.

Mr. R. B. Angus has resigned from the directorate of the Montreal Street Railway Co., Montreal, and has been succeeded by Mr. James Ross.

Messrs. Healey Bros., of Munster, Ont., are constructing a telephone line from Richmond to Stittsville and Carp, a distance of about 30 miles.

A new 700 light incandescent plant, purchased from Messrs. Ahearn & Soper, of Ottawa, is being installed by the St. Hyacinthe Gas Co., St. Hyacinthe, Que.

A new company is about to commence the manufacture of electric machinery at Oakville, Ont., under the name of the Oakville Electric Manufacturing Co.

The Chambers Electric Light Co., of Truro, N.S., to meet the demands of their increasing business will add to their present plant a 100 horse power engine and 500 light dynamo.

The Council of the Township of York have granted to the Toronto & Scarboro' Electric Railway Co. an extension of time for one year for the construction of the road to Little York.

The Montreal Street Railway Co. are experimenting with the fender selected by the Fender Committee of Boston and recommended by the Railroad Commissioners of Massachusetts.

At a recent meeting of the Directors of the Galt & Preston Street Railway Co., Mr. T. M. Burt was elected President, and Mr. Fred. Clare, Vice-president and Secretary and Treasurer.

The vacancy on the Board of Directors of the Royal Electric Co., caused by the resignation of Mr. G. R. Robertson, has been filled by the election to the position of Mr. Alfred Brunet.

It is said to be the intention of the Danville, Que., Slate Co,, to construct an electric railway to carry freight and passengers from their quarries to Danville station, a distance of three and one-half miles.

The City Council of Hamilton have passed a by-law extending the franchise of the Hamilton & Dundas Railway to the year 1913, and authorizing the company to substitute electricity for steam power.

Mr. G. J. Scott, of Oshawa, Ont., has been given the contract for the construction of a police and fire alarm telegraph system for the town of Collingwood, Ont., at the price of $528.00, exclusive of wiring.

The Ottawa Car Co. have just completed a new three story building in which to manufacture electric cars. Outside the building a drum elevator is being constructed for raising the cars from the first to the upper floors.

The Reliance Electric Manufacturing Co., Limited, of Waterford, Ont., write us in contradiction of rumors which have been to some extent current of late to the effect that their position financially had been affected by the failure of a local banking house at Waterford. The company state that only a portion of their banking business was done at this institution, and that their position will in no wise be affected by its failure. They further state that their company has operated at a profit from the time it commenced business until the present, and that it is to-day in a financially strong position.

Mr. J. L. Harris, of Moncton, N. B., is the leading promoter of a company recently organized at that place for the purpose of constructing an electric railway. The construction of the road will be commenced at an early date.

The Dominion Government has given a contract to the Canadian General Electric Co , of Toronto, and Messrs. Ahearn & Soper, of Ottawa, for the construction of ten electric motors, with which to operate the locks at the Sault Ste. Marie Canal.

It is said to be the intention of the Nova Scotia Telephone Co., to commence immediately the construction of a metallic circuit line between Truro and Halifax. The company claim that this line when finished, will equal the metallic circuit lines between New York and Boston.

The amalgamation of the horse and electric street railways of Winnipeg, was consummated on the 1st of May, and the horse cars are at once to be withdrawn. The rate of fare which prevailed prior to the cut in rates, brought about by the competition between the two companies, has been restored.

The Windsor, Sandwich & Amherstburg Electric Railway Co., have, it is reported, decided to build the line to Amherstburg during the present summer. The river route will be adopted, and the line equipped with vestibule cars. Construction will begin almost immediately.

Mr. I. Viau, has made application to the City Council of Hull, Quebec, on behalf of a company who are desirous of obtaining a 50 years franchise for the construction and operation of an electric railway to connect the city of Hull with Aylmer, Gatineau Point and Ironsides. The matter has been referred to a committee.

The City Engineer of Toronto and his assistant have gone on a visit to the United States for the purpose of inspecting some of the municipal electric lighting plants, and securing data which will enable the City Council of Toronto to decide whether or not it would be to the advantage of the city to own and operate its own lighting plant.

In connection with the double tracking of the Niagara Falls Park and River Railway, surveys have been made with a view to the straightening of the road. These surveys show that the steel towers of the upper suspension bridge project four feet into the street, and that the south-east corner of the Clifton House projects even farther upon the highway. The courts will be asked to decide whether or not the bridge company can be compelled to remove the towers.

Application for incorporation is being made by the Niagara River Tramway Co. The object of the company is to construct a cable tramway across the Niagara River for the conveyance of passengers. The headquarters of the company is to be at Niagara Falls, and its capital stock is $40,000. The promoters are: John Flett and Joseph Tait, M.P.P., Toronto; L. C. Raymond, Welland; R. N. Campbell, Niagara Falls, N.Y., and G. W. Pound.

Notice is given of the application for incorporation of the Colonial Telephone and Telegraph Co., Limited, of Niagara Falls, Ont., with a capital of $25,000. The applicants are: Jacob Dilcher, Buffalo, N.Y., banker; James Bampfield, gentleman, and John Joseph Bampfield, merchant, both of Niagara Falls, Ontario; James Francis Cleary, Troy, N.Y., broker; Henry Steinert, counseller-at-law, and John Harrington, merchant, both of the city of New York, U.S.; of whom the three first are to be the provisional directors of the said company.

The City Council of Hamilton have refused to adopt the recommendation of the Board of Works, that Frank B. Rae, of Detroit, be paid a retaining fee of $300 and a commission of five per cent of the cost to estimate for and put down an electric plant for the city. This is taken to mean that for the present, at least, the city authorities have abandoned the intention of attempting to purchase plant and do their own lighting. The Hamilton Electric Light & Power Co., are reported to have submitted to the council a proposition to continue to light the city for a further period of two years, at the price of 28 cents per lamp per night.

An agreement has been arrived at between the amalgamated electric light companies of Ottawa, and the Council of that city for the lighting of the city for the period of ten years from the 1st May, 1895. The lamps are to be lit in accordance with the moonlight schedule. The price is to be $65 per year for each 2000 c. p. lamp with a discount of 25 per cent. on private lights. These prices are not to be increased unless the company should be compelled by law to place their wires underground. The city is to have the right to string wires on the company's poles without charge and of allowing others to string wires by paying the company a reasonable compensation for the privilege.

On the afternoon of the 1st of May, a fire broke out in the incandescent light department of the Royal Electric Co.'s works at Montreal. The fire brigade were at the time on parade, having been called out for inspection by the Governor-General. They were consequently not in as good condition as they would otherwise have been to deal with the fire. When they arrived on the scene the whole of the western building on Prince street was in flames, and beyond their ability to save. They succeeded, however, in saving the offices and dynamo house. The incandescent station and pattern room were destroyed, and during the progress of the fire a large fly wheel attached to the engine exploded, the fragments flying in all directions and carrying away the roof of the building, but without causing injury to the crowd surrounding the building. The company's loss is variously estimated at from $25,000 to $50,000, and is understood to be covered by insurance.

Messrs. Scott Bros., who have lately purchased the municipal lighting plant from the town of Seaforth, Ont., have purchased a site on which to erect a brick power station, in which it is proposed to install two large boilers, a powerful engine, and a complete incandescent light plant. For these purposes, about $12,000 will be spent.

The annual meeting of the shareholders of the Royal Electric Co., was held at Montreal on the 3rd of April. The gross revenue for the year was shown to have been, $487,365.70, and the expenses $375,517.93 leaving a balance of $111,857.77. Out of that sum dividends were declared equal to 8 per cent. on the stock amounting to $77,047.14, leaving the sum of $34,810.63 to be carried to the Profit and Loss account.

The suit for damages brought against the Royal Electric Co., by Mr. Fred. Thomson, who was formerly electrician of the company, came up for argument in the Montreal Courts a fortnight ago. Mr. Thomson claims $2,000 for wrongful dismissal, while the company contend that his including Prof. Elihu Thomson, of Lynn, Mass., brother of the plaintiff, and dismissal was due to incompetency. A number of well-known electrical people Mr. J. J. Wright, manager of the Toronto Electric Light Co., were called upon to give expert evidence in the case. A decision has not yet been reached.

PUBLICATIONS.

The May Arena closes the ninth volume of this leader among the progressive and reformative reviews of the English-speaking world. The table of contents is very strong and inviting to those interested in live questions and advanced thought.

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THE EXPANSION OF CHIMNEYS.

It is seldom that facilities are afforded for the making of exact measurements of the expansion and contraction of a factory chimney. It is generally conceded that boiler chimney shafts should not be attached to the walls of any important building on account of the risk of cracking the walls by the expansion of heated brickwork, but data on the subject are scanty, and there are even persons who have doubts whether brickwork really expands or contracts when heated. An excellent opportunity of settling this question has recently presented itself in England. It was necessary to erect a casing of ornamental brickwork around a boiler chimney of 90 feet high, the inside of which was provided with a brick flue up to over one-third of its height. The near completion of the brickwork surrounding the chimney gave the opportunity of observing from the top of the casing any movement of expansion or contraction of the chimney itself. As the boiler fires were drawn on Saturday afternoon, and relighted on Monday morning, the chimney cooled down, and observations made from the top of the casing will show a contraction of the chimney of 5 millimeters, or 2-10 inches during that time. As the surrounding wall was still about six feet below the top of the chimney when the measurements were made, and the first 33 feet of the shaft remained practically cold on account of the air space between it and the centre flue, it may be taken that the length of the brickwork in which the expansion took place was about 50 feet. According to this a shaft 100 feet high would expand 4-10 inches when in use. It is probable that the expansion observed would have been 50 per cent. greater if the chimney had been allowed a longer time to cool down.

A Smiths Falls paper tells of a lamp installed by the Packard Lamp Co. of Montreal, which was in continuous operation for 4,584 hours.

SPARKS.

The Supreme Court has dismissed the appeals taken by the Royal Electric Co., in the suit brought against it by the City of Three Rivers, and in connection with its suit against E. Leonard & Sons.

The Amherst, N. S., Gazette, states that it is extremely doubtful if there is to-day in the Maritime Provinces a single electric light company doing business on a paying basis, notwithstanding that coal is obtainable at a very low figure.

The Packard Electrical Co., of Montreal, is asking for incorporation. The applicants are Packard Bros., of Warren, Ohio; Howry Bros., of Saginaw, Mich.; and A. McKenzie, barrister, of Toronto. The capital of the proposed company is placed at $300,000.

The hotel-keepers of Brantford are said to be utilizing electricity to escape detection for selling liquor after hours. It is said that watchers are stationed outside the building, and when an officer is seen approaching, a button is pressed and by this means the lights are extinguished.

Application is being made for incorporation by the Dominion Gas and Electric Co., Winnipeg, Man. The company ask for power to manufacture gas and electricity for commercial purposes, and apparatus and appliances for use in connection with the production of gas and electricity. The capital stock of the company is to be $1,000,000.

The bill to amend the charter of the Hamilton Radial Electric Street Railway Co., which came up for consideration recently in the Ontario Legislature was strongly opposed by the solicitor for the Grand Trunk Railway, and several of the members of the House, who contended that it gave to the electric roads powers and privileges in excess of those extended to the Grand Trunk and other old established railroads in which large capital was invested. Mr. Gibson, the member for Hamilton, and a deputation of citizens from that city supported the measure on the ground that the construction of such a road would assure cheap and ready access to the market of Hamilton. The preamble of the bill was passed. The bill substitutes the name "Hamilton Radial Electric Railway" for that in which the company was first incorporated, and authorizes the construction of tracks to be operated by any power except steam in various directions, radiating from Hamilton to Guelph, Berlin, Oakville, Niagara Falls, Brantford and Mimico. It also authorizes an increase in the capital stock of the company to $2,000,000.

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Sealed tenders will be received at my office up to 5 o'clock on TUESDAY, MAY 15TH, for the

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of the City of London, for a term of 1, 3, 5 or 8 years. Plans and Specifications may be seen at my office.

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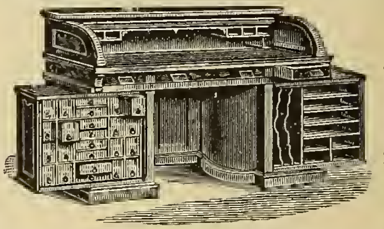

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Large Stock on Hand

JOHN FORMAN, Agent, : 650 Craig Street, Montreal

SPARKS.

A five years' franchise for lighting the streets of Amherstburgh, Ont., has been granted to Mr. W. H. McEvoy.

Mr. W. S. Shaw's electric plant suffered destruction in the fire which recently wiped out the greater part of the town of Huntsville, Ont.

An act has been approved of by the Government, granting power to the Bell Telephone Co., to issue debentures or bonds from time to time to the amount of 75 per cent. of its actual paid up capital stock.

The application of the London Springbank Electric Railway Co., for a charter to construct an electric railway from London to the neighboring suburb of Springbank, was refused by the legislature. The application was strongly opposed by the Mayor and citizens of London, on the ground that it would interfere with the water supply of the city.

On the 15th of April, the large fly wheel attached to the engine in the electric light station at Chatham, Ont., burst into pieces. Fortunately, Mr. Robert Trott, the electrician, and his assistant, Mr. J. R. Edwards, escaped uninjured. It is said that the wheel was too light for the duty it had to perform. A local paper starts off its report of the accident in the following highly imaginative and amusing manner: " It was not a case of the twelve foolish virgins who had neglected to see that a good supply of oil on hand. The array of promptly paid electric fluid bills amply attested to keener business principles. As this sudden darkness came at an hour when merchants most require light a great deal of vigorous "kicking" was indulged in, and anathemas were wafted skyward from all quarters."

It is announced that power is being sought from the legislature of New York State, for the incorporation of a company to run a line of observation cars suspended from a cable 50 feet above the Niagara River, and following the crest of the Canadian and American Falls. It is proposed to suspend the cars, which will be entirely of glass and iron, from a cable two inches in diameter. In this connection it may be mentioned that a serious accident took place a few days ago on the suspended railway at Knoxville, Tenn., a brief description of which was given in the ELECTRICAL NEWS recently. The hauling cable broke, and one passenger was killed by the recoil of the broken end crashing into the car. The balance of the passengers were let down to a steamer anchored beneath the cable way. It seems doubtful whether suspended cable ways of this character will ever be very popular.

A dispatch from St. John, N. B., states that plans were laid by local and American speculators to secure at a ridiculously low figure, the assets of the Consolidated Electric Co., of that city. When the time came for the sale of the property, however, the speculators were greatly surprised by the action of Mr. E. C. Jones, representing the Bank of Montreal, who entered the bidding and forced the price up far beyond the figure at which they had concluded they could obtain the property. Mr. Jones was finally declared the purchaser at the price of $92,000. There are said to be liens amounting to about $30,000 against the property, and these will have to be paid off, but it is considered that Mr. Jones secured a great bargain. One of these liens for $20,000 is held by the Bank of Montreal, and it is understood that it was with the view of securing payment that Mr. Jones was instructed to take the action he did. It is further understood that the Bank of Montreal are acting in concert with Messrs. James Ross, R. B. Angus, Holt and other well-known capitalists of Montreal, who will become the proprietors of the road, and who propose to put it in a condition of first-class efficiency, and will expend over a quarter of a million dollars for this purpose.

The Bell Telephone Co'y
OF CANADA, LTD.
MONTREAL
MANUFACTURES AND HAS FOR SALE EVERY DESCRIPTION OF
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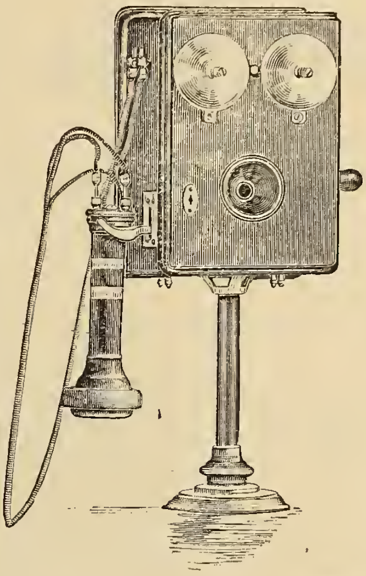
Will also furnish tenders to Cities, Towns and Villages for FIRE ALARM AND POLICE PATROL SYSTEMS.

Catalogues will be furnished on application.



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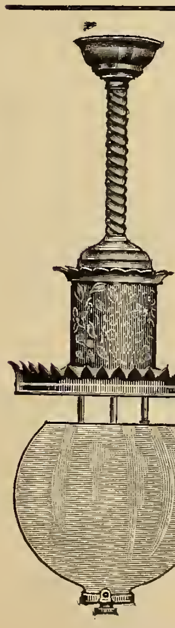

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Direct-Incandescent or Alternating Circuits.

IT IS WITHOUT A COMPETITOR ON ALL CIRCUITS SINGLY OR IN SERIES.
It is not affected by the flashing of machine.
IT CAN BE REPAIRED BY ANY ONE.
It is much more reliable in action and would save the cost of patrolmen.
The energy expended on the electro magnets' mechanism to operate most arc lamps is utilized in THE EXACT to enhance its candle power. Its resistance is lower than any other lamp.
By using this lamp all the requirements of a city for power arc and incandescent lighting may be met by an alternating plant, thereby saving cost of direct generators, engines, shafting, line construction and maintenance of same, thus reducing the cost of installing and maintenance nearly fifty per cent.
One lamp can be burned on a 5 light transformer and from 25 volts up.

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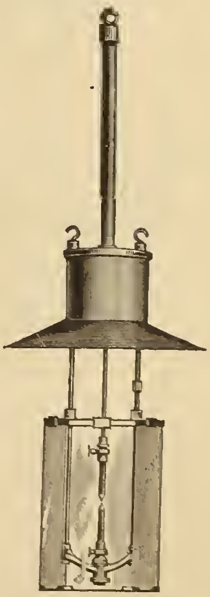

For street lighting.

TRADE NOTES.

Mr. John Forman, Montreal, has secured the contract to fit up the paper-bag factory of Alex. McArthur & Co., with a large Crompton Motor, and to wire the factory for incandescent lights.

The Robb Engineering Co., of Amherst, Nova Scotia, are at present engaged in manufacturing their first direct connected engine for electrical work. The engine is being manufactured for the Canadian General Electric Co.

The Vulcanized Fibre Co., of Wilmington, Del., and 14 Dey St., New York, have issued a neat calendar of convenient size, which besides giving sizes, weights, prices, etc., of the vulcanized fibre which they manufacture, includes a description of the material, and describes some of the uses to which it is applicable in the electrical and mechanical world. We learn that vulcanized fibre is produced by treating specially prepared vegetable fibre with powerful chemical agents, whereby the exterior portion of each separate fibre becomes glutinous, and while in this condition the whole mass is consolidated under very heavy pressure and becomes practically homogeneous. After this the chemicals are extracted, the mass is manipulated, rolled, pressed and cured by various methods. The material is made both hard and flexible according to the use to which it is to be put. The material is largely used for insulating purposes in electrical work.

Following is a copy of a letter recently received by the Magnolia Metal Co., New York:

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CABLE ADDRESS—"FAIRBANKS."

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Gentlemen:—We are compiling a new catalogue, comprising all the articles which we are now selling in our department of Railway and Manufactory Supplies. We desire to take this opportunity to add to the line of goods which we are handling, and would like to make arrangements with you to take up the sale of your goods and illustrate the same in our catalogue. The book we intend to issue will consist of 300 pages of the size of 8 x 11½ outside measure, and will be placed in the hands of every customer of ours, both at home and abroad. We handle only the highest grade of goods, and BELIEVING THAT YOUR MANUFACTURES ARE STRICTLY FIRST-CLASS IN EVERY RESPECT, we wish to give you an opportunity to have them listed in our catalogue to the extent of one or more pages, provided you are willing to bear the expense, which will not be great. The cost of distribution will be borne by us.

Please favor us with an early reply, as we are making this offer only to a limited number of manufacturers, and our book will shortly be ready for the press.

Yours truly,
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(Signed) R. L. T. Evans.

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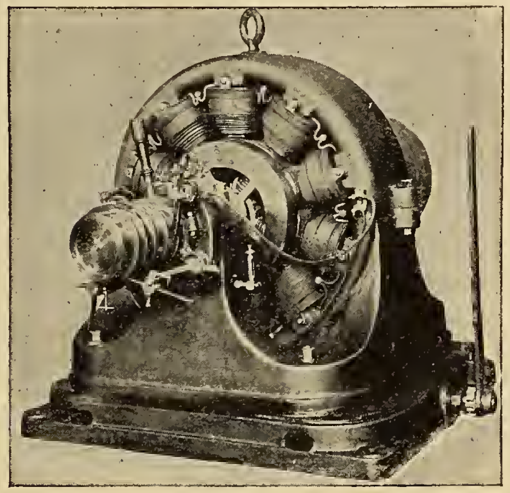

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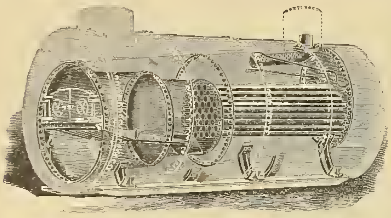

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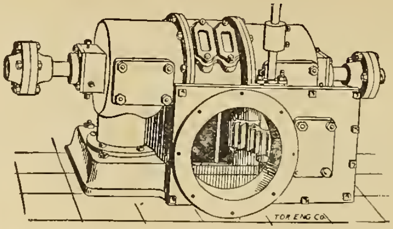

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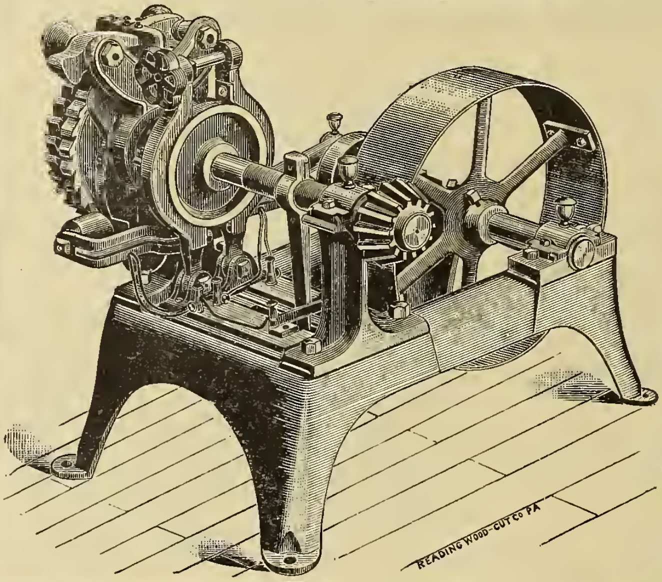

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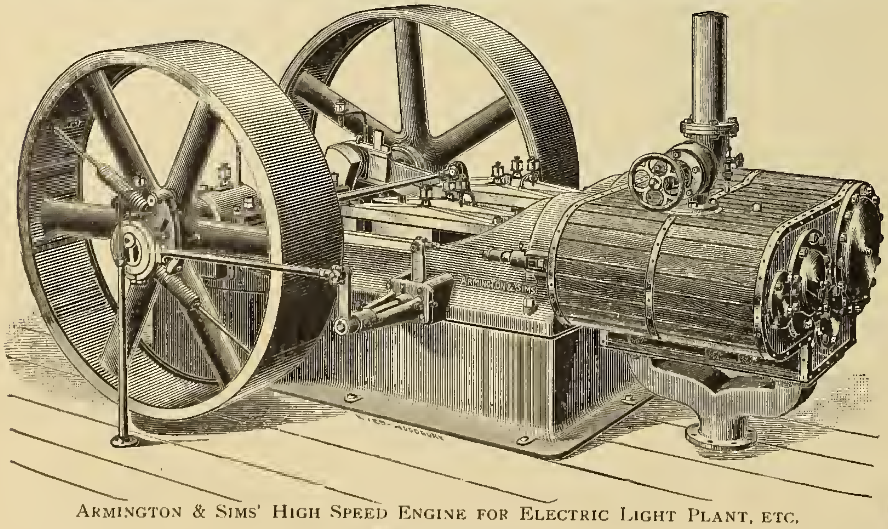

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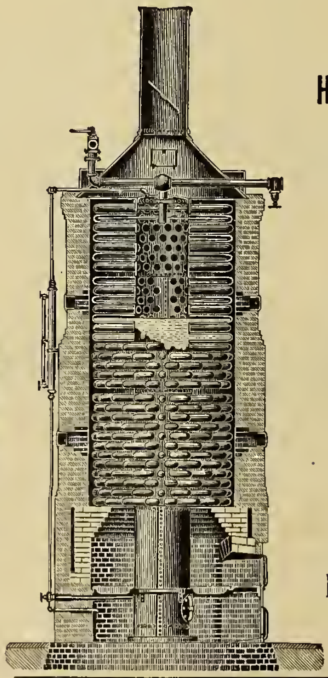

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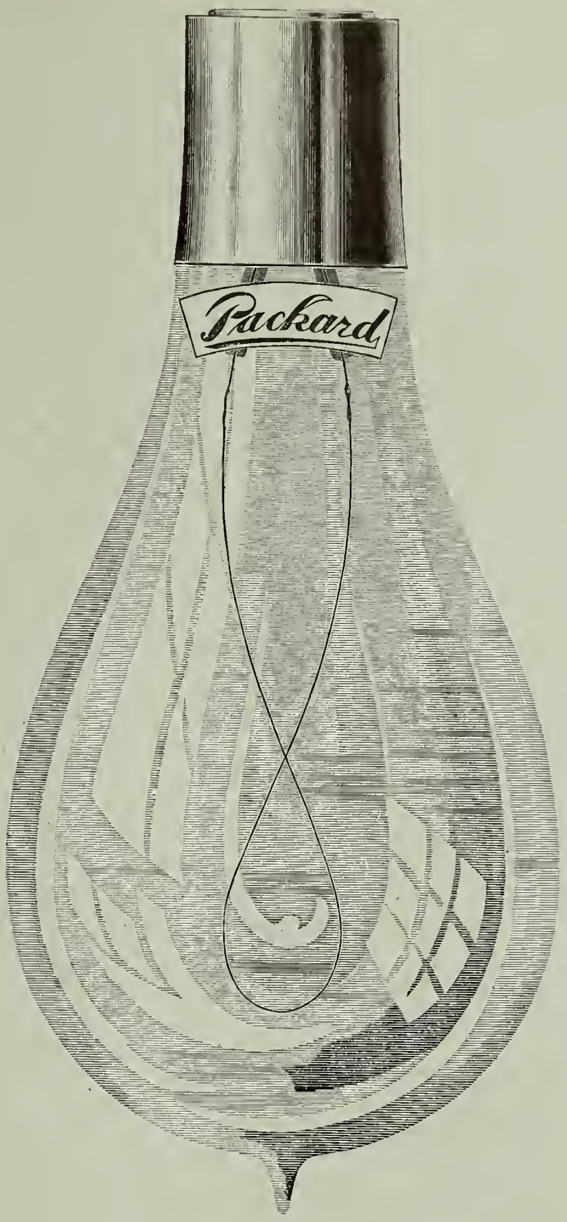

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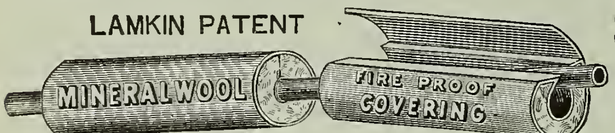

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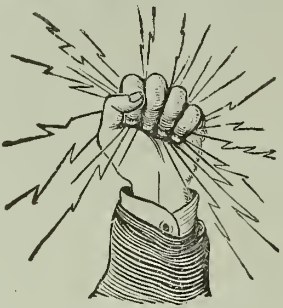

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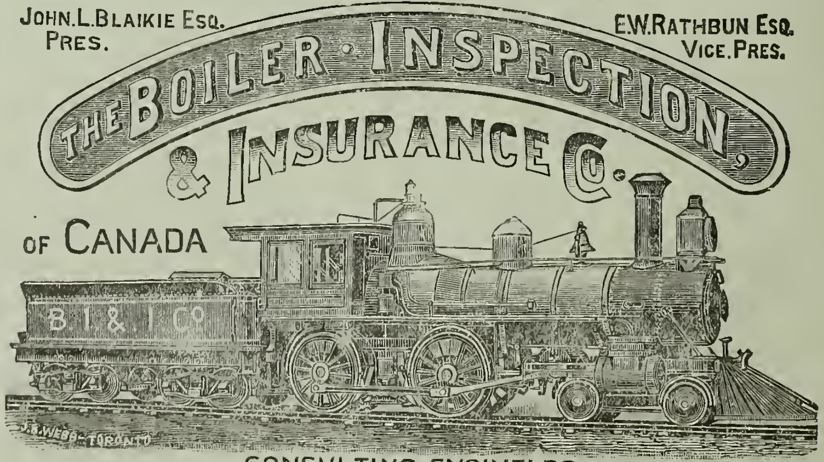

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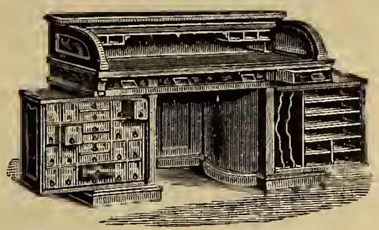

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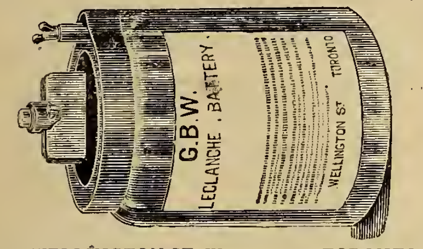

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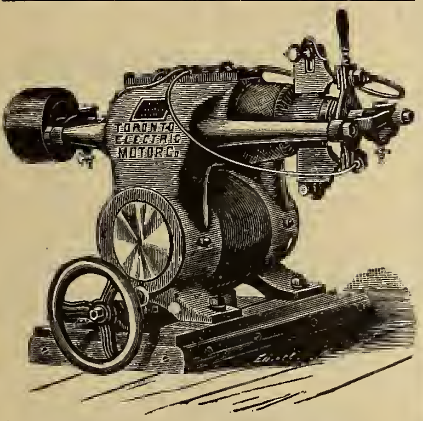
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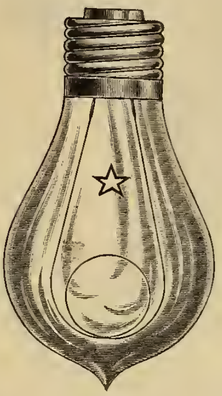

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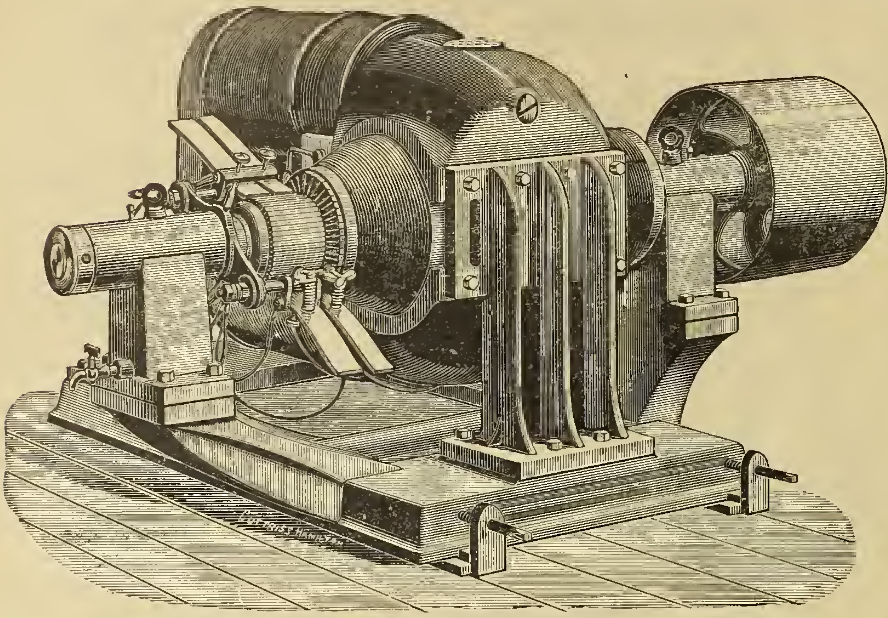

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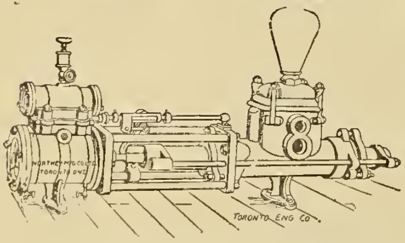
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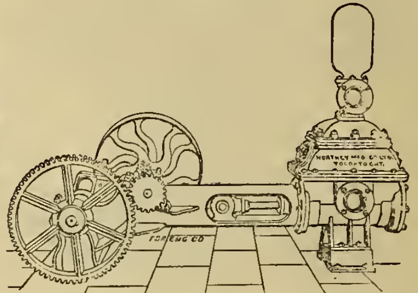

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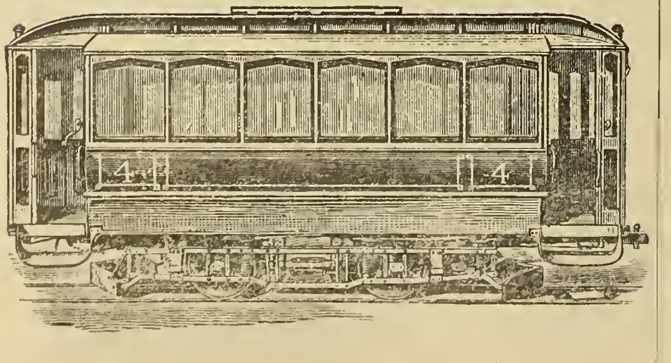

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Canada, Sept. 12th, 1893.
United States, Sept. 19th, 1893.
Great Britain, Sept. 19th, 1893.
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Specially Designed for Warehouse and Factory Use.

Send for new catalogue No. 7.

SAMPLE LETTER.

MONTREAL, Oct. 10, 1893.
MESSRS. T. W. NESS & Co.,
749 Craig St., Montreal, P. Q.

DEAR SIRS:—In reply to yours of the 9th, we beg to say that we have used one of your Automatic Telephones for some time, and find it satisfactory in every respect.

Yours truly, GREEN & SONS CO

T. W. NESS & CO.
749 Craig St. - MONTREAL.
Toronto Branch: 165 King St. W.

CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. IV. JUNE, 1894 No. 6.

MR. ECKLEY B. COXE.

IN connection with the outline of proceedings of the approaching convention of the American Society of Mechanical Engineers in Montreal, which is printed elsewhere in this paper, we have the pleasure of presenting to our readers a portrait and sketch of the President of the Society, Mr. Eckley B. Coxe, of Drifton, Pa. For the data employed in this sketch we are largely indebted to an article by Mr. Wm. Kent, M.E., in Cassiers' Magazine.

The newly-elected president of the American Society of Mechanical Engineers, Eckley Brinton Coxe, has been for many years one of the leading spirits in the engineering profession. In April, 1871, his name was the first signature to a circular issued by a committee consisting of R. P. Rothwell, Martin Coryell, and himself, calling a meeting of mining engineers, to be held at Wilkesbarre in May, to organize the American Institute of Mining Engineers. At this first meeting of the Institute he was elected one of its vice-presidents and in 1878 and again in 1879 he was elected president. Being a frequent contributor to the "Transactions of the Mining Engineers," and a constant attendant at its meetings, and being head of the well-known firm of Coxe Bros. & Co., the largest private corporation producing anthracite coal, his name and face are more familiar to the mining than to the mechanical branch of the profession, but since his work has been pre-eminently in the mechanical line, as in the invention and construction of machinery for mining, conveying, and separating of coal, and since the mechanical branch is indebted to him for the translating and editing of Part I. of Weisbach's Mechanics, the American Society of Mechanical Engineers has as much right to claim him and to elect him its president as had the older society.

Eckley B. Coxe

Eckley Brinton Coxe was born in Philadelphia, June 4th, 1839. He graduated from the University of Pennsylvania in 1858. After completing a course in the scientific department of that institution, he was engaged six months in topographical geological work, in the anthracite coal region of Pennsylvania. In 1860 he went abroad to continue his studies. The next two years were spent at the Ecoles des Mines, in Paris, and then a year in the Bergakademie at Freiburg, Saxony. He subsequently spent two years in visiting and studying the practical operation of the mines of England and the Continent. With his brothers he inherited large coal estates in Pennsylvania, and his entire education had been directed with the special object of preparing him for their management. Consequently upon his return to the United States in 1865, Mr. Coxe, in company with his brother, under the firm name of Coxe Bros. & Co., began the business of mining anthracite coal in the Lehigh region. Since that time he has been engaged in the operation of his company's collieries.

In the operation of these mines he has won a high reputation as one of the most progressive, able and honorable representatives of the great coal mining industry.

In 1880 Mr. Cox was elected to the Senate of Pennsylvania.

Mr. Coxe is a member of other engineering and scientific bodies besides the two of which he has been chosen president, among them the American Society of Civil Engineers, the Engineers' Club, and the American Association for the Advancement of Science. He was one of the vice-presidents of the last named at its New York meeting in 1887.

THE LONG DISTANCE TELEPHONE.

A FEW weeks ago a business man in New York city telegraphed to the owner of a big poultry farm in a small town in Illinois to go to Chicago and "meet" him at a certain hour on the long-distance telephone line that now places New York on speaking terms with Chicago. The Illinois farmer kept the appointment, and the two conversed together over the wires for half an hour.

At the end of the conversation, the Illinois man emerged from the telephone booth, paid his $54 with entire satisfaction, and exclaimed with great glee: "Great Scott! I've just sold a hundred thousand chickens!" This little episode "points a moral and adorns a tale." Such a text needs little expounding to a circle of business men, such as comprise the majority of the readers of this magazine. Take the first point:

Correspondent No. 1 telegraphs from New York to Chicago to correspondent No. 2 at some provincial town in Illinois, to go to Chicago in order that he may talk to him. Point the second: They talk for half an hour at a cost of $54. If a personal meeting had had to be arranged, they would probably have talked for several hours before coming to a settlement, the time spent in traveling by one of them would have been from three to four days at a minimum and the actual expense about $100.

Point the third: A sale amounting to, say at least, $20,000, was effected with great promptness, and without the intervention of any middleman. Surely no better illustration of the business possibilities of the long-distance telephone could be desired.—Engineering Magazine.

CUTTING MICA.

AT the glass-house the mica is put into shape for shipment. The The blocks vary greatly in size. One from the Wiseman mine, near Spruce Pine, is reported to have been six feet long by three wide. Pieces a yard in diameter have been obtained at the Ray mine, in Yancey county, and similarly plates have been found in Siberia, but these are exceptional. The average block is a little larger than the page of a magazine, and is generally less than six inches in thickness. It separates very readily into sheets parallel to the base of the prism. It is estimated, says C. H. Henderson, in the Popular Science Monthly, that this cleavage may be carried so far that it would take three hundred thousand of the mica plates to make an inch. It is needless to say, however, that such a thickness is not suitable for service in stoves and furnaces. The mica is generally split into plates varying from about ⅛ to 1-64 of an inch in thickness. In preparing these plates for market, the first step is to cut them into suitable sizes. Women are frequently employed in this work, and do it as well as, if not better than the men. The cutter sits on a special bench which is provided with a huge pair of shears, one leg of which is firmly fixed to the bench itself, while the movable leg is within convenient grasp. It is requisite that the shears shall be sharp and true, for otherwise they will tear the mica.

The patterns according to which the mica is cut are arranged in a case near at hand. They are made of tin, wood, or pasteboard, according to the preference of the establishment. Generally they are simple rectangles, varying in size from about four square inches to eighty.

A telegraph line is in process of construction by the C. P. R. Telegraph Co., from Kingston to Ottawa, via the Rideau Canal route.

MONTREAL JUNIOR ELECTRIC CLUB.

AT regular meetings of the above club held on the dates below mentioned, papers were read and discussed as follows :—

April 23rd.—Paper by S. W. Smith on "Direct Current Dynamo," part 1st.

April 30th.—Paper by R. H. Street and H. O. J. Overton on "Electric Light and Bell Circuits."

May 7th.—Paper by Geo. Morris on "Steamboat Lighting by Electricity." (This paper was read before the Montreal Electric Club by R. W. Herring.)

May 14th.—Paper by Wm. T. Sutton on "Storage Batteries," part 2nd.

ADVANTAGES OF DIRECT CONNECTED DIRECT CURRENT GENERATORS.*

By W. N. STEWART.

MY remarks refer to electrical work over areas not exceeding three miles in any direction from the power house, in cities with 35,000 population, with streets lighted by arc lamps, and stores and residences with either arc or incandescent lamps, motive power being supplied as required, and the service extending over the 24 hours.

In a model, 500 H. P. plant, the essential machinery would be a 100 H. P. multipolar generator, directly connected to a compound engine running at 250 revolutions per minute ; one 400 H. P. multipolar generator similarly connected and running at 170 revolutions ; both engines being condensing when water is available. The generators to be built for 220 volts if used on a three wire system and 480 volts if used on a five wire system ; the three wire for distances not over one mile, and five wire where they exceed one mile. Also 120 cells of storage battery, 30 amperes for 15 hours, for the three wire system, and 240 similar cells for the five wire system, these batteries to be used as an equalizer and regulator as well as to supply current. The usual switchboard and accessory apparatus would also be necessary. The wiring would consist of one circuit of mains and feeders to supply all customers with light or power, each consumer to have a meter connected to the outside wires. This plant could be operated by one engineer, one fireman, superintendent and the necessary lamp trimmers.

If the three wire system be used, a common grounded neutral wire could be used for both public and private lights, the arc lamps being connected in groups of two between the positive and neutral. If the five wire system obtains, they could be connected in groups of eight, each lamp having its automatic cut out. The necessary resistance should be in the line wire, iron wire being used in some cases, or copper wire not smaller than No. 8.

Apropos of the belief that resistance is waste of power, and therefore to be avoided. If the ordinary arc dynamo† give 78 per cent. efficiency and the constant potential machine 95 per cent., we have a difference of 17 per cent. in favor of the latter, and as the resistance for low tension arc lamps never exceeds 15 per cent. of the current, we have an advantage of 20 per cent. in favor of the system under consideration. Then we eliminate the friction of the belting which means a loss of 10 per cent., increased to 18 per cent. if a countershaft is used. Thus, in this case, 12 per cent. is gained, in the other 20 per cent.

The operation of such a station would commence by starting at 4 P. M. the small dynamo, the current from which would flow to the storage batteries. At dusk the large machine would be started, and the current would be divided between lights and the battery, until all the lights were burning, when the battery would act as a regulator. From 10 P. M. until 2 A. M. the current would be devoted principally to the charging of the batteries. This would mean an employe's working day of ten hours, the operation of the machines at full efficiency, and a battery working day of fourteen hours. Storage batteries are now extensively used in Europe and in some American stations with excellent results.

In our station we have one slow speed machine in operation at one time doing all the work, with an efficiency of 95 per cent., without loss in belting or shafting, and minimum repairs ; ten hours daily run, current available day and night ; low pressure wiring, hence no damage suits for personal injury ; longer life and less blackening of incandescent lamps, the battery keeping the current uniform ; less investment for real estate and buildings ; less liability to breakdown ; no burned out machine or armatures, less oil, fewer employes, no losses in transformers. The economy in such a station would be 40 per cent. over one run on the antiquated methods.

The high speed engine and belted dynamo are disappearing, and the direct connected slow speed combination is being adopted *because it pays to make the change.* The multipolar generator is almost perfection, its high initial efficiency is maintained for many years ; it has an armature winding of solid copper bars ; only about 20 per cent. of the current is used for the fields. Not less than $46,500 per annum economy is attained on the 17,500 incandescent lamp at the Chicago Auditorium, by the use of a direct connected plant, and equally favorable results are reported from other places. No reasons exist for managers retaining their obsolete apparatus and methods. In most places it would pay to sell the old dynamos and lamps, and adopt the direct connected combination and newer methods, which experience shows to be the most economical.

TELEPHONES.*

BY N. HOLLAND AND J. A. SHAW.

Before describing the construction of the telephone of to-day, we will consider what are the requirements of an instrument for transmitting speech and how they are met by inventors.

In transmitting speech electrically, the transmitter has to so control the current in the line that it will be able to reproduce at the distant end the three characteristics of a musical note, *pitch, loudness* and *quality.*

In the diaphragm at the distant end the pitch would correspond to the number of vibrations, or, as our alternating current friends would say, "the number of cycles passed through" in unit time. The loudness would depend upon the amount or amplitude of the fluctuations in each cycle ; the quality depending on the form or nature of these fluctuations ; and the necessary condition of a successful system of telephoning is the ability to reproduce these characteristics.

The first of these is very easy to reproduce, as of course, if we open and close the circuit sufficiently rapid we can get the period required.

It was on this principle that the much talked of Ries' instruments were made. His transmitter had a stretched skin diaphragm, with platinum points in the centre to make and break connections, and the receiver consisted of an electromagnet, which gave out sounds as it was magnetized and demagnetized. As the current was broken at every vibration caused by the sound in the transmitter, the sounds given out by the magnet were necessarily of the same pitch as those at the transmitter. Mr. Ries thought that the amplitude was also to some extent obtained by the varying length of contact in the transmitting instrument, but judging from the result of recent telephone investigation, it is highly probable that this was due, not to the duration, but to the varying degree of firmness of the contact.

The transmitters in commercial use to-day are constituted on two principles : 1st, By magnetic induction ; 2nd, By varying the resistance of the circuit. It was on the first of these principles that Graham Bell took out his now famous patent of 1877. When first brought out it was intended for both transmitting and receiving, but owing to the improvements in microphonic transmitters, it has now been used principally as a receiver. As it is this receiver (very little altered from the time it was put on the market) that is now used altogether, it would perhaps be excusable to give a short description of the way it is made, and how it performs its duties.

A laminated permanent magnet is used, as in this form it is less likely to lose its magnetism than if it were solid. On the end of this magnet is fixed a boxwood spool, having a soft iron core, wound with 1300 turns of 36 silk-covered wire, with a resistance of about 75 ohms. This magnet and spool is placed in a hard rubber shell, and has opposite to it, with its plane normal to the axis of the magnet, a thin ferrotype iron diaphragm about 2¾ inches in diameter, being held at the edges by the cover, cut in a convenient shape for the mouthpiece, which screws on, leaving it free to vibrate in the centre. Two receivers connected in series (no battery being required) constitutes the simplest form of telephone circuit.

The actions that take place in the instruments are as follows :—A person talking into the transmitting receiver throws its iron diaphragm into rapid vibrations. The diaphragm being close to the permanent magnet is magnetized by induction, and as it vibrates its magnetism is constantly changing, being strengthened as it approaches the magnet, and weakened as it recedes from it. This undulating magnetic field will in turn induce currents in alternate directions, in the coil of wire before mentioned. These currents traverse the whole length of the circuit ; passing through the coil of the distant instrument. When the direction of the arriving current is such as to strengthen the power of the permanent magnet, it exerts a stronger attraction on the iron diaphragm, whereas, if it flows in the contrary direction, the permanent magnet is weakened, allowing the diaphragm to spring back. Thus any motions given to the diaphragm of the transmitting receiver are reproduced in the other. It follows from this, that words spoken at one end will be repeated at the other, though much enfeebled by the many transformations which take place.

There are numerous transmitters using the second principle of varying the resistance in the circuit, but nearly all of them are carbon in some form or other, and may be classed under three heads : Carbon Pencil, Granulated Carbon, and Platinum and Carbon. The Carbon Pencil is the most simple form of transmitter, though not much used on this side of the Atlantic. The Granulated Carbon is believed to be the best for long distance work. Perhaps the best form of this is the Hunning, which is much used for long distance transmission on this continent, notably between Detroit, New York, Chicago and Boston. The "Gower Bell" instruments are used between London and Paris ; the latter end using the Carbon Pencil variety.

The third class, the "Platinum Carbon," gives the most perfect articulation, and it is under this head that the Blake transmitter comes—the transmitter which is in almost universal use on the continent. It is too well known to need description. Its action is due to the varying pressure between the platinum point and the carbon button, which, altering the resistance of the circuit, allows more or less current to flow. The diaphragm is to present enough surface for the sound waves to act on.

An induction coil is generally used with a microphone transmitter, the primary being in series with a cell of Leclanche Battery and the transmitter contacts, and the secondary being in circuit with the receiver and the line. The object of this is two-fold : 1st, The local circuit being short and of small resistance, the varying resistance at the carbon contacts is greater in proportion than if connected direct to line, and also as there are a great many more turns in the secondary than in the primary, the potential is increased. Having a good transmitter and receiver, it still becomes necessary to have some kind of signalling apparatus calling attention to the 'phone. For short distance, such as warehouse instruments, the ordinary battery and vibrating bell does very well, but as the distance becomes greater this would become impracticable, as it would require too much battery power ; so that we now use a ringing set composed of a generator, having a permanent magnetic field and a Siemens armature of the H type. This armature is 2½ inches long and is wound with 2500 turns (500 ohms) of 36 silk-covered wire, wound equally on each side of the shaft. It has no commutator, so that the current is sent in alternations to the line. A polarized bell is used, the armature being kept polarized by the permanent magnet.

As both the ringing and the talking are done on the one line, a switching arrangement must be made so as to cut the different circuits to line ; this is performed by means of the hook which holds the receiver. This hook also automatically disconnects the battery when not in use. We might also state that armature of the generator is short circuited, except when in the act of ringing up.

We will now call your attention to the way these circuits are "wired in" in the instrument itself. Referring to this diagram which is wired in shunt and is the way that the Bell Co. wire their instruments.

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*Abstract of a paper read before the Northwestern Electrical Association, Milwaukee.

†Dynamos Electric Machinery : Prof. Sylvanus Thompson.

* Paper read before the Montreal Electric Club.

CONVENTION OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS IN MONTREAL.

THE American Society of Mechanical Engineers will meet in convention in Montreal from the 5th to the 9th inst. Tuesday will be spent in viewing the city. The first session will be held on the evening of the 6th inst. The meeting will take place in the Molson Hall of McGill University, where addresses of welcome will be presented by the Mayor of the city, Mr. Herbert Wallis, Chairman of the Local Committee, and the Chancellor and Faculty of the University,

Papers will be read and discussed on the following subjects :

"Notes on the Theory of Shaft Governors," by A. K. Mansfield.

"Heat by Units and the Specifications for Pumping Engines," by Albert F. Hall.

"A New Recording Pressure Guage for Extremely High Ranges of Pressure," by W. H. Bristol.

"A Note on Compressed Air," by Frank Richards.

"The Relation of the Drawing Office to the Shop in Manufacturing," by A. W. Robinson.

"The Theory of the Steam Jacket; Current Practice," by R. H. Thurston.

"Results of Experiments with a 50 Horse-power Single Non-Condensing Ball & Wood Engine to Determine the Influence of Compression on Water Consumption," by D. S. Jacobus.

"Cylinder Proportions for Compound Engines, Determined by their Free Expansion Losses," by Frank H. Ball.

"A New Method of Compound Steam Distribution," by F. M. Rites.

"Cost of a Small Electric Railway Plant," by Jesse M. Smith.

"Power Losses in the Transmissive Machinery of Central Stations," by W. S. Aldrich.

"Rustless Coatings for Iron and Steel," by M. P. Wood.

"Corrosion of Steam Drums," by C. W. Hunt.

"First Stationary Steam Engines in America," by F. R. Hutton.

"Cost of an Indicated Horse-power," by DeCourcy May.

"A New Form of Canal Waste Weir," by John R. Freeman.

"Effect of Varying the Weight of the Regenerator in a Hot Air Engine," by G. W. Bissell.

"Mechanical Draught for Boilers," by W. R. Roney.

"The Saturation Curve as a Reference Line for Indicator Diagrams," by R. C. Carpenter.

"Results of Measurement of the Water Consumption of an Unjacketed 1,600 Horse-power Compound Harris Corliss Engine," by Messrs. Denton, Jacobus and Rice.

"Notes on the Corrosion of a Cast Steel Propeller Blade," by F. B. King.

A reception wlll be tendered in honor of the visitors on Wedesday evening by Sir Donald A. Smith, at his residence, 1157 Dorchester street ; and a graden party on Friday afternoon at Piedmont Hall, the residence of Mrs. J. H. R. Molson. On Wednesday afternoon the visitors will go by G. T. R. to Lachine and run the rapids, proceeding afterwards by steamer to the Isle au Herron, where luncheon will be served under the direction of the Harbor Commissioners. On Saturday the visitors will proceed by train to Ottawa and spend the day in seeing the points of interest at the Capital.

A TELEPHONE CABLE TEST.

THE following data, furnished to Electricity, New York, by Mr. C. W. Swoope, are said to be the record of a test such as is usually made both at the factory and after laying in conduit upon a section of a telephone cable, and may be of interest as an example of the usual mode of procedure. The test includes the measurement of insulation, resistance and capacity—conductivity being omitted—and the test here given was made upon a cable wound upon a reel and immersed in a tank of water for about fifteen hours before being tested.

Size of cable, fifty-one pairs of No. 18 B. & S. wire ; four layers ; wires insulated with dry paper ; length 560 feet = 9.42 of a mile.

Insulation test made with 500 volts from Clark's Standard cells, galvanometer constant being 512,000 megohms = 1 deflection.

Deflection with conductors all bunched, 25 = 2,048 megohms.

Deflection of insulation, leads free = 0.

Deflections of every fifth wire singly in each layer :

1st layer, 2-2-2-2-2-2 deflections.
2d " 1-1-1-1-2-2 "
3d " 2-2-2-2 "
4th " 1-3 "

Average deflection, 2.

$$\frac{512000}{2} = 256000 = \text{megs. per 560 feet, or 27126 megs. per mile.}$$

Resistance test by Wheatstone's Bridge, several wires promiscuously chosen from each layer :

Outer layer 3.902 3.851 3.848 3.818 ohms—3.854 average.
2d " 3.875 4.408 3.892 " 4.058 "
3d " 3.857 3.955 " 3.906 "
4th " 3.895 " 3.895 "

3.854 × 45 (wires in layer), + 4.058 × 32, + 3.906 × 20, + 3.895 × 4 is equal to the sum of the average resistances of all the wires in the cable, and divided by 102 (wires in cable) equals 3.930, equals the average ohms resistance of one wire. Subtracting the resistance of the leads (.347 ohms), we get 3.583 ohms at 3.5° C. = 3.749 ohms at 15.5° C or 35.515 ohms per mile at 15.5°.

Capacity test by 30 Standard Clark cells (30 volts) :

1st layer—Deflections : 196, 198, 208, 208, 204, 205, 202, 203, 200, 200, 200, 200, 200, 200, 200, 200. Average 201.5

2d layer—Deflections : 185, 184, 185, 185, 196, 198, 188, 193, 194, 185, 186, 193, 193, 192, 192, 188. Average, 189.

3d layer—Deflections : 190, 192, 194, 195, 191, 192, 190, 191, 194, 195, 190, 191. Average, 192.

4th layer—Deflections : 200, 194, 198, 198, 200, 200, 205, 206. Average, 200.

Deflections by pairs : 120-118 (1st layer), 100-100 (2d), 100-100 (3d), 128-128 (4th). Average, 112 less capacity of leads, 6 = 106. Standard deflection from condenser by .01 microfarad : 225-225-225-225 = 225 average less leads, 3 = 222.

The average capacity is obtained in the same manner as the average resistance and equals 195 less 10 for leads = 185, corrected average. The highest capacity of any one wire in cable = 208 less 10 = 198. The lowest capacity of any wire in cable = 185 less 10 = 175.

The capacity is found as follows : $K = \frac{D \times K_1}{D_1}$

when D = deflection produced by cable's charge,
D_1 = deflection produced by .01 microfarad in condenser,
K = capacity of cable,
K_1 = capacity of condenser.

Thus the average $K = \frac{185 \times .01}{222} = .0083$, or .0781 microfarads per mile ;

the highest $K = \frac{198 \times .01}{222} = .0089$, or .0838 microfarads per mile

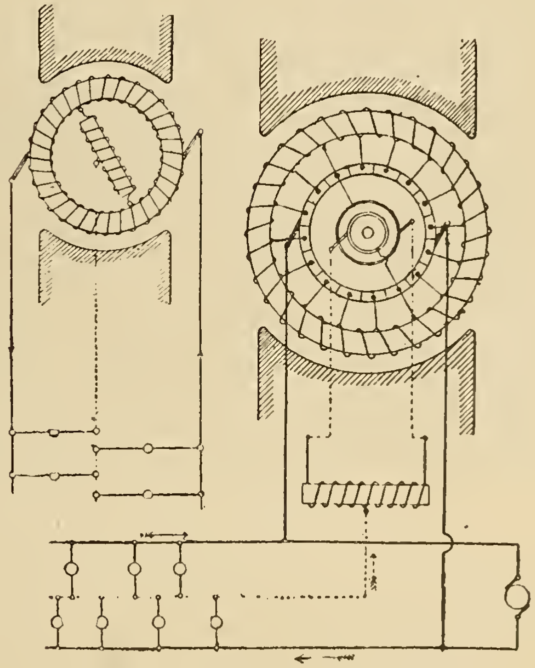
the lowest $K = \frac{175 \times .01}{222} = .0081$, or .0743 microfarads per mile.

THREE-WIRE DISTRIBUTION FROM A SINGLE DYNAMO.

THE Fires-Lille Electric Co., of France, says Electricite, has recently patented a device which allows of an electrical distribution on the three-wire system from a single dynamo. It consists in the adaptation to the dynamo of a strong self-induction coil. Fig. 1 shows the device, the two brushes being shown as bearing directly on the armature to simplify the explanation. These are connected to the two outside wires of the three-wire system.

A low resistance coil possessing considerable self-induction is connected to two opposite points on the armature and turns with it. The neutral is connected to the centre of this coil. In case of a difference of load between the two sides of the system, this wire and each half of the coil, the ohmic resistance which offers but little obstacle to the passage of continuous current, serve to conduct the current back to the machine and maintain the pressure constant. As a general thing, however, it will be necessary to have this coil separate from the machine. The two ends would then be connected to two rings connected to two diametrically opposite bars of the commutator. This device may also be used to regulate the current in three-wire central stations at some distance from the source of supply. To this end one or more dynamos with self-induction coils (Fig. 2) are connected to the principal conductors and operate as motors, the neutral wire of each sub-station being connected to the centre of the coil of each motor-regulator or equalizer, which can also operate as a generator. This device can also be applied to multipolar generators.

FIG. 1. FIG. 2.



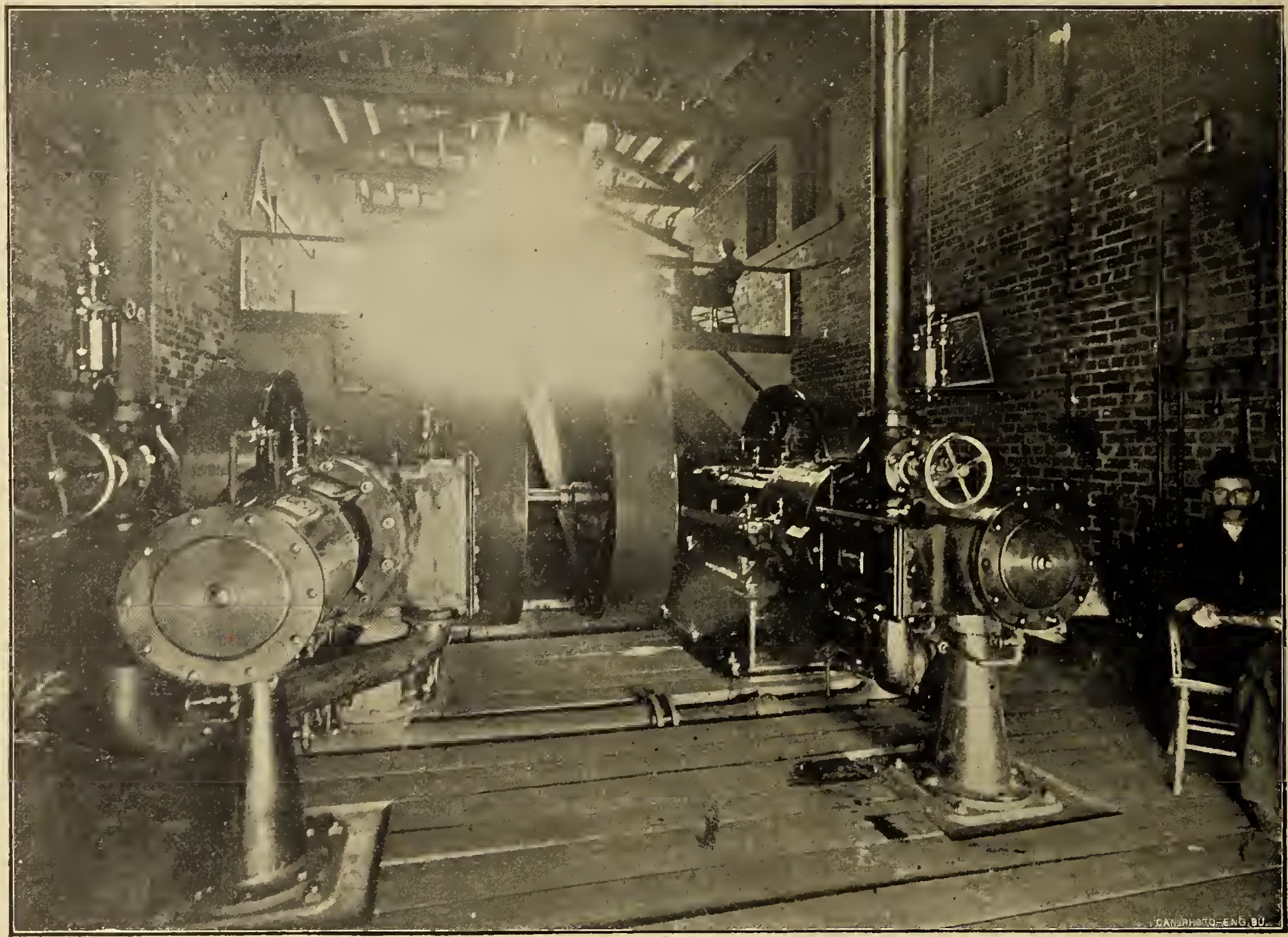
THREE WIRE DISTRIBUTION FROM ONE GENERATOR.

ELECTRIC LIGHTING IN ST. JOHN, N. B.

By A. H. McC.

Probably no other city in Canada is so well lighted as is St. John, New Brunswick, certainly there is none better lighted. This is not an idea that finds a resting place in the minds of a few persons only, for strangers coming here from large centres of population are quite willing to acknowledge that the streets of this city are as well lighted as any they have seen. There are four electric lighting concerns in the city, namely, the Consolidated Electric Co., D. W. Clark & Sons' electrical works, a small station run by the city, and the Gas Company's electrical works.

Of the four the latter is the larger. Its building is situated on the corner of St. James and Wentworth streets. It is built of brick and is 100 feet square. The main building is 100 x 40 feet, and the boiler and coal bins 100 x 60. There is not an electric lighting station in Canada better equipped for its size. The electrician and superintendent is Mr. Frederick Mount. This company have six tubular boilers of 96 h. p. each. Four of these boilers are on one side of the chimney, and the remaining two are on the opposite side. The boiler room is 28 feet wide with 30 feet left for coal, which is deposited through hatches and falls down within a few feet of the furnaces. The coal bins will contain 600 tons. This concern's chimney is the largest in the city, being 120 feet high. The interior is round, 6 feet in diameter. They have two feed water heaters and two pumps each of sufficient capacity to feed all the engines in case one gives out. There are seven engines, 3 150 h. p. bi-compounds, and four simple engines. Only three of the latter are kept working, the remaining one being held in reserve. The larger compound engine was the first of its kind ever built in Canada. E. Leonard & Sons, of London, Ont., were the makers. The simple engines are from 70 to 90 h. p. Two of the high speed engines are belted direct to a countershaft, and are run connected in that manner, with both governors in use. An invention of Mr. Mount's has enabled him to run them in this manner. This invention is chiefly intended for use in connection with high speed engines, operated in pairs, having a shaft between or common to both engines, and separate governors on each engine. It is intended to enable the engineer to properly regulate or divide the load at will. Belted to this pair of engines are four arc dynamos of the Thomson-Houston system, one of 30 and three of 50 lights capacity, also one incandescent machine of 1200 lights capacity, with exciter. To the other compound is belted another incandescent light machine of 1200 lights capacity, with exciter. The three simple engines are belted to arc machines from 20 to 50 lights capacity. All the arc lights are 2,000 candle power. This company run about 300 commercial arc lights, and 2,400 incandescent lights. The latter are both commercial and domestic. The company contemplate taking out all the simple engines, and placing in their stead high speed automatic compounds, similar to those now in use. J. M. Robinson is president of this company and Geo. Ellis, secretary.



Two Tri-Compound Engines in Gas Company's Electric Works, St. John,. N.B., Showing Connections.

In 1890 the Eastern and the New Brunswick Electrical Co. were formed. They ran independently of each other until 1892, when they were amalgamated under the name and style of the Consolidated Electric Co. Their building is situated on the corner of Union and Smythe streets. It is of brick 100 x 40 feet. The cut which is furnished was taken when some new machinery was being placed in position. This company's steam plant consists of four Heine boilers of 100 h. p. each and one Manning vertical of 200 h. p. The engines which are at present in use consist of two 150 h. p. McIntosh & Seymour tandem, and two 250 cross compounds, one 100 h. p. Armington & Sims, and one 90 h. p. Leonard Ball simple. They have 1000 horse power square condenser supplied with water from the harbor a distance of 400 feet by a circulating pump, driven by a T. H. F. 40 railway motor, which supplies 1500 gallons a minute. New engines of greater h. p. will be placed in the building at an early date. The electrical plant consists of four No. 16 Edison dynamos of 125 volts, 3 Slattery alternators of 1,250 lights capacity, four No. 8 Wood arc dynamos and three 35 Brush lighters. There are 133 street arc lights of 2,000 candle power each, 3000 incandescent lights on the Edison system of 16 candle power each, 2,100 on the alternating system of 16 candle power, and 90 commercial arc lights. This company is composed of a number of Canadian capitalists, with W. C. Van Horne, of the C. P. R., and James Ross, of Montreal, at the head. Charles Jones is Manager, and A. R. Bliss, Electrician.

The concern that is owned by the city is on Main street, north end. It is small and does not furnish over 40 arcs and about 100 incandescents. There is nothing particularly interesting about the plant. The other concern, of which we have already made mention is in the west end of the city (Carleton). It is also small, furnishing about 25 arcs and between 50 and 75 incandescents. It may be interesting to note that in 1893 the city was assessed $19,061 for street lighting, $300 more than in 1892.

The incandescent lighting plant recently installed by the Royal Electric Co. at Aurora, Ont., consists of a twenty-four K. W. alternator with exciter. From one dynamo are run incandescent lights for stores and a series circuit of twenty-three c. p. lamps and two alternating arc lamps for street lighting. The generating machinery is driven by a thirty-five H. P. Leonard Ball engine. The machinery is housed in a solid brick station, thirty by forty feet in size.

A NEW BATTERY PLANT.

Editor CANADIAN ELECTRICAL NEWS.

SIR,—Messrs. H. Morgan & Co., the large dry goods firm of Montreal, have lately made a new departure in the Canadian practice amongst private lighting plants.

They have for some time past followed the usual custom of generating their electrical current for lighting purposes during the greater part of the day; previously they received all the current required for night purposes from the Royal Electric Co., through a small transformer. Their electrician, Mr. McMurtrie, conceived the idea that this cost could be greatly discounted by means of a far better arrangement.

CONSOLIDATED ELECTRIC COMPANY'S BUILDING, ST. JOHN, N. B.

Throughout the day steam has always been used in this store for elevators and other purposes in addition to the necessary basement lighting, therefore to generate a trifle more current during that time would have no appreciable effect upon the coal bill and would need no increase whatever in the generating machinery or labor required. He therefore suggested that a small battery should be added to their present equipment that could be easily charged during the day time and would be sufficient to entirely dispense with the services of the local lighting company at night—thus crediting their monthly bill against simply the first cost of the battery.

This perhaps sounds very nice on paper, but Canadians have already learnt how very treacherous are many of the storage batteries that flood the market. Mr. McMurtrie was also well aware of this fact, but he wisely did not judge *all* batteries by *some* batteries, neither did he make any hasty conclusion before a complete investigation.

The various periodicals soon told him that Europe had been successfully handling batteries for some time past and that in the "old country' there are many similar installations to the one he was requiring, and further that their success was amply proven by the annual increase in their number and size. When companies are willing to spend $75,000 on batteries alone there surely must be a considerable commercial advantage in them?

The Crompton-Howell E. S. Co., of London, England, have made several sales to that extent, and so Messrs. H. Morgan & Co., through their electrician, soon decided to put equal confidence in that company's goods and purchased, in the autumn of last year, a battery of sufficient capacity for their purpose.

This plant commenced its work during January last and has given complete satisfaction ever since that date. It easily carries all the night load that is required and it is recharged again by such machinery as is always running during the hours of the day.

There are other and special advantages also gained by this improvement, as it is now possible to switch on without running any special machinery; and this at seasons of special work, must always be a great convenience. Another important item is, that if a break-down unexpectedly occurs to their machinery the battery is at hand as a reserve and can carry no less than 200 amperes for a considerable period. Engineers of any experience are fully aware of the value there is in this factor of safety.

The characteristics of this type of battery are its high efficiency, its great durability, its low cost of maintenance, and its capability of standing such high discharge rates. It is perfectly safe and practicable to discharge these batteries at times within an hour and at a rate of 3½ times as great as the normal discharge rate. The result of this "step in the right direction" has been that the owners of many other similar plants in Montreal are considering like improvements and some have already erected batteries.

The advantages to be obtained from such plants vary more or less in each individual case, and it is extremely easy to form erroneous ideas of the size required for any one installation. It is therefore wise to always get advice on this matter while considering it. I might add that this plant is being charged from a Crompton straight current dynamo.

The Canadian agent for this battery company is Mr. John Forman, of 650 Craig street, Montreal,

Yours truly, C. W. SULLY.

THE BLAKE VS. KILLEY PUMPING ENGINE.

Editor ELECTRICAL NEWS.

SIR,—In answer to Mr. Mackie's letter in your May issue re the Blake pumping engines, in which he says I must have been mistaken or misinformed, I would like to say that my information was from a blue print copy of the official paper. Mr. Mackie received his information from a paper of that date. I leave the reader to judge which is the most likely to be correct, the newspaper or the exact copy of the record of test; also, if Mr. Mackie would look a little closer at the figures he would see that 13·6% and not 15½% is allowed for refuse in the Blake test. Mr. Mackie says the steam for heating the engine room was not considered during the Hamilton test. Hamilton is a pretty hot place in summer (I have been there): it must be a very cold place in winter if they require to steam heat their engine rooms.

Mr. Mackie further says that if the Hamilton test had been conducted in the same manner as the Toronto test, the Killey pumps would show 4,000,000 ft. lbs. higher duty than the Blake pump. This would be a duty of over 136,000,000 ft. lbs., a duty never heard of, except from Hamilton.

Again, sir,-I am acquainted with men who assisted Mr. Galt in making the test at Toronto, and who will swear that during the Blake test every bit of coal used was shoveled right out of the pile just the same as while running at any other time, and was not hand picked.

The Blake test has been copied by mechanical papers from one end of the continent to the other, and very favorably commented upon. Toronto wants the best, irrespective of where it is made or of the cost. Perhaps Mr. Killey will pardon me if I use his words in this matter, and say that "Commercial appreciation is the best test in this matter," as well as between the high and low speed engines.

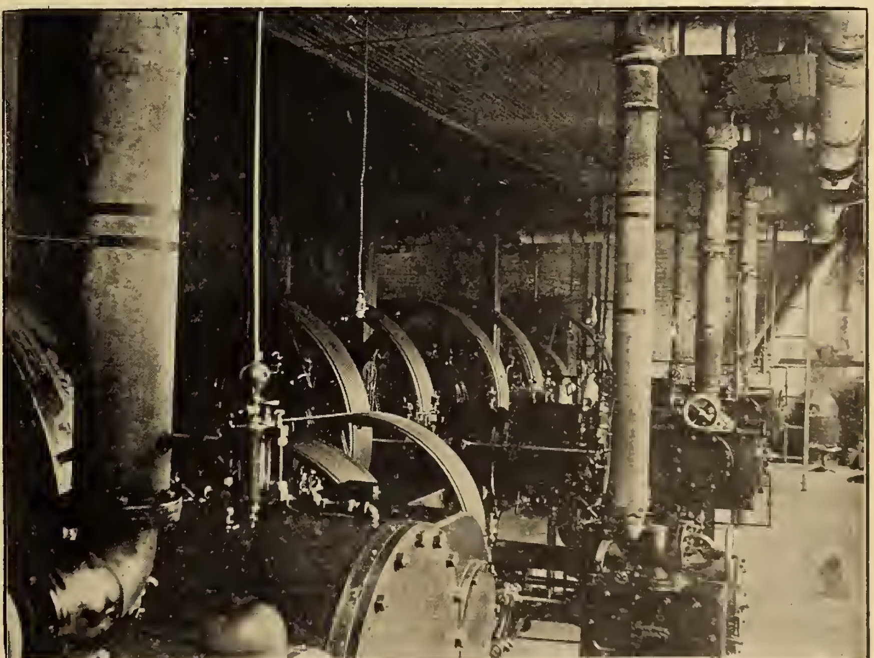
No, Mr. Mackie, put an automatic cut-off steam valve motion on your Killey pumps and I have no doubt mechanical men would consider them first-class. However, if Hamilton is satisfied with Killey pumps, we in Toronto will try to be content with the Blake.

Yours truly, G. C. MOORING.

SPARKS.

The new incandescent station of the Royal Electric Co., to replace the one recently destroyed by fire, will be made fire-proof.

The shore end of the Commercial Cable Company's new cable was successfully landed from the cable ship Faraday, at Canso, N. S., on the 9th of May. The work occupied about eight hours, and was superintended by Mr. Alex. Siemens, managing director of Messrs. Siemens Bros. & Co., and Messrs. Brittle and Jacob, chief cable engineer and chief electrician, respectively.


VIEW OF CONSOLIDATED ELECTRIC COMPANY'S PLANT, ST. JOHN, N. B.

The Street Railway Gazette, of Chicago, is apparently unacquainted with the geography of its own country when it locates the city of Port Huron in Ontario.

The Nictaux Electric Light & Power Co., has been organized with headquarters at Middleton, N. S. The promoters are, Dr. A. P. Reid, of Halifax, and Dr. S. N. Miller, of Middleton. The proposed capital is $50,000 in 50,000 shares of $1 each.

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Correspondence is invited upon all topics coming legitimately within the scope of this journal

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NOTICE OF REMOVAL.

Subscribers and advertisers are asked to note that on the first of May the Branch Office of the **CANADIAN ELECTRICAL NEWS** in Montreal was removed to the New York Life Insurance Building.

A STORY is going the rounds to the effect that recently the permission of the Underwriters' Association was requested for the placing of a converter in the basement of a Methodist church in a Western Ontario town, and that the irreverent reply received from the Association's inspector was that no "conversions" must be allowed in a Methodist church.

THE past month has witnessed the closing down of manufacturing establishments in the United States and Canada for lack of fuel caused by the strike of workmen at the mines in the United States. It is a great hardship and injustice that thousands of workmen and their families should be deprived of their means of living by the action of persons with whom they are not in the remotest degree connected. Second alone to the hardship inflicted on the workmen is the inconvenience and loss imposed on manufacturing and railroad companies. One outcome of the experience of the past few weeks is likely to be increased attention to the endeavor to provide a satisfactory substitute for coal for steam producing purposes.

THE vexed question of the duty on rails for electric street railways, a question which arose in consequence of the ambiguous wording of the exemption clause in the old tariff, has been referred to before in these columns. The matter at last came before the courts at a sitting of the Exchequer Court, held in Toronto the latter part of April, to hear the case of the Toronto Street Railway Company, which was suing for the recovery of duties paid on rails imported for use in Toronto. The question at issue turns upon the interpretation of the word "railway" in the exemption clause of the statute, and as this clause in the new tariff is an exact repetition of the clause in the old tariff, the question is still of immediate interest and importance. It has more than one bearing upon projected electric railways and has been the cause of much uncertainty and annoyance. Judgment in the case of the Toronto Railway Company will settle whether an electric railway operating entirely within one municipality is properly exempt or not. But even if the rail for such a road are dutiable, there has hitherto been a doubt whether a road connecting two municipalities would not come within the meaning of the word "railway" in the exemption clause; or even whether a future intention to connect two municipalities, such as would be implied by a corporate name for a road containing the names of two towns, would not be sufficient to entitle the rails for use in any part of the road to free entry. It is hoped that the judgment in the Toronto Railway case will cover all these points and definitely settle the whole matter. The judgment, which it is expected will be delivered sometime this month, will be looked for with more than ordinary interest.

IN view of the conviction which seems to have fastened itself on the minds of municipal councils in a number of Canadian towns and cities, that a great advantage would accrue from the municipality owning and operating its own electric light plant, it may not be out of place to re-print the following extract from a local paper regarding the experience of the town of Seaforth which has lately disposed of its lighting plant. The paper in question referring to the sale of the plant says: "Notwithstanding the loss the town has suffered in this matter, we believe the people decided wisely when they voted to part with it, as a private company can run a business of this kind much more efficiently and economically that the council can where the members are being changed from year to year."

IN an exhaustive discussion of the subject of the intrinsic value of street railway investments, conducted by Mr. Edward E. Higging in the Street Railway Journal, the author arrives at the following conclusions: 1. Well managed electric street railway systems of from 25 to 40 miles in length in the best American cities of from 50,000 to 100,000 inhabitants will probably develop a maximum earning power of from $5.00 to $6.00 gross per capita, with one or two exceptional cases rising above these figures; a large number will earn from $4.00 to $5.00 per capita; and few will be unable to earn $4.00 per capita. 2. Those properties which have been improperly constructed and equipped, particularly in the matter of roadbed, cannot probably be permanently operated at less than 75 per cent. of the passenger income, higher figures rather than lower being probable. Those properties which have postponed equipment until a comparatively recent period and which have been carefully and thoroughly built can usually be operated at from 65 to 70 per cent. of the passenger income. 3. Under the most favorable conditions of operation a maximum net earning power of about $2.00 per capita is possible, but more usual figures will range from $1.00 to $1.50 per capita. 4. $1.50 per capita is a return of 12 per cent. per annum on capital liabilities of $12.50 per capita, which represents about the average present cost of building and equipping in the most perfect manner electric railway systems of average length in cities of this class, where the cost of taking up and replacing pavement forms an important item of original investment. In general therefore it may be said that these properties are, intrinsically, investments returning from 10 to 15 per cent. on the actual value of tangible assets apart from franchises.

ELECTRICITY is charged with being the cause of many destructive fires. While beyond doubt it is saddled with a larger measure of blame in this particular than it deserves, it must be admitted that the accusation is in a measure well founded. Competition in electric wiring has become so keen, that prices are reduced to a point where it is impossible for first-class work to be done. As a result, we learn that in some Canadian cities, first-class wiremen are unable to secure employment, while the work which should be their's is being done by incompetents, who in many instances are without any qualifications whatever. The consequence is that buildings are being wired in the most ignorant and dangerous manner, and to those conversant with the facts, their destruction by fire at any time would occasion no surprise. Electricians need not be told that by the use of the best modern methods of insulation, the wiring of buildings can be done so that the fire hazard will not in the slightest degree be increased. Unless prompt action be taken, however, by reputable electrical companies, to put a stop to cheap work by unskilled workmen, the use of electricity in buildings will soon be regarded as so highly dangerous that it will largely be abandoned and the interests of all engaged in the business will sustain such injury as perhaps never can be repaired. All electrical manufacturing and supply concerns who wish for the continued growth of electric lighting should join hands with the underwriters in demanding that the standard of electric wiring shall be raised to the point of safety. This is a subject that might well receive attention at the hands of the Canadian Electrical Association, whose province it is to guard and promote the interests of every legitimate electrical industry. Electricity is being given a bad name, of which it is undeserving, and which, if its future is not to be compromised, it must be freed from as speedily as possible.

THE question of municipal versus private ownership of electric street lighting plants is one which is now being agitated in several places. In a matter of such importance it is of grave moment that the whole subject should in each case be thoroughly canvassed and investigated, before the city undertakes a new and onerous responsibility which, if the decision be a hasty one, based upon superficially plausible grounds, may easily result in a continual drain upon the pockets of the taxpayers, and a new discredit to the principle of municipal control of any department whose operations are of an industrial character. The proposition is that if a private company finds it to its profit to maintain a plant for furnishing street lights at a contract price, the city, by undertaking this service itself, must save to the taxpayers the profit which previously went to the shareholders of the company. But against this there is a strong and almost universal feeling that a civic corporation cannot carry on any business as economically and efficiently as is done by a private company. Without the slightest reflection upon the ability and integrity of the permanent civic officials, and apart from all questions of political influence or corruption, the lack of continuity of control inherent in our system of municipal government, and the control by men elected for other considerations than their especial fitness for the business in hand, place the civic corporation at such a disadvantage that in competition with it a private concern will earn a profit which is the wages of ability and fitness. That is the feeling that has grown up in the popular mind, and it is fair to assume that it is not without grounds in experience. Call it popular prejudice, and it still remains to be shown from what inadequate or obsolete causes the prejudice arose. Added to this feeling is the distrust, which has been too often justified, that attempts to make use of the department in the strife of municipal politics, will hamper the best efforts of faithful and capable permanent officials. The result is that to satisfy the taxpayer at the present time that any benefit will accrue to him from municipal ownership of the street lighting, the advocates of this plan must show that the gap between the cost and the contract price for lighting is much wider than can be spanned by a moderate profit on the capital invested. Whether by their fault or misfortune, civic corporations have a poor reputation for business management, and the burden of proving the contrary rests with them. The advocates of municipal ownership and operation must clearly prove that the lowest obtainable contract price for the lighting service yields an inordinate profit on the actual investment needed to give this service. If they cannot do so, they have no case.

THE city of Evansville, Ind., recently undertook an investigation of the relative cost of street lighting under public and private ownership. The report has been republished in the technical press and has been widely circulated. It contains in tabulated form, interesting and valuable statistics of municipal lighting of both public and private ownership, gathered from a large number of towns, and no doubt for this reason has been reprinted as an appendix to the report recently made on the same subject by the City Engineer of Toronto. But the body of the Evansville report does not commend itself either in tone or matter, as the thoughtful and well considered presentation of the subject which is required to furnish grounds for action in a matter of such importance. The city has been using a little less than 200 arc lamps burning all night on the moonlight schedule at a contract price of $158.30 per lamp per annum. The committee states its conclusions after "a careful investigation," and the first one is that "our city is now paying sixty per cent. more for her street lighting than she ought to do." If correct, this is a comment upon the business capacity of the city to make a fair bargain, which is not calculated to inspire confidence in its fitness to be entrusted with the more difficult and responsible job of operating a plant economically. The second conclusion is that "fifty-five cities doing their own lighting pronounced the same a complete success,"—they naturally would—and that "we have ascertained" that their average cost is $57.88 per lamp per annum. "Ascertained" is a strong word to describe an unquestioning acceptation of statements of results, without investigation of how these statements were compiled. Without examining the system of book-keeping in each case there is no certainty that all items of cost are properly charged. The results are mere matters of opinion, nor is the average of 55 opinions which vary—as shown by the tabulated statistics—from $36.00 to $115.00 per lamp, of any value to start a business on. The third conclusion states the average cost of contract lights at $114.58 per lamp per annum. This is a matter of fact, being, as shown by their tables, the average of 22 facts varying from $80.00 to $160.00. They conclude fourthly that the city should have about double the number of lights it now has, and finally that the first cost of a plant with 350 lights would not exceed $75,000—which seems about right—and that "the annual cost of maintaining such a plant would not exceed $50.00 per lamp per annum." They give no reasons for this faith that is in them, but it is charitable to hope that some sort of estimate was made of running expenses, and that $50.00 is not merely a deduction from the averages they pin their faith to—averages of plants of all sorts and sizes scattered from Maine to California, and therefore no doubt peculiarly applicable to a 350 light plant at Evansville, Ind. They of course recommend a municipal plant, and any defects in the joints of their argument as above constructed are neatly plastered over by a statement that "Your committee has also ascertained"—what again!—"that municipal ownership of all plant, such as waterworks, street railways, lighting and others necessarily requiring franchises from the public, should, in the opinion of the best thinkers of the age, who have studied municipal government, be owned by the public, instead of by private corporations." From all of which it is perfectly plain why "your committee is of the opinion that a new contract for our street lighting could now be let for a much lower price than the present contract calls for, but we do not believe it to be for the best interests of the citizens of this city for her lighting to be done by private contract." We have devoted a good deal of space to the consideration of this report, as it has been given a wide publicity and we think it deserves to be held up to admiration as a model of how not to do it. What would a business man think if he were asked to embark on a business enterprise on the strength of such a futile prospectus as this report? If the taxpayers of Evansville are contented with statistical averages and platitudes about the best thinkers of the age, they deserve what they are likely to get if they operate a municipal plant controlled by the framers of this report. But we trust that in Canada this business problem will be treated in a business manner.

MR. Keating's report to the Board of Works on the probable cost of an electric street lighting plant for Toronto was made to a meeting of the Board on May 28th. It presents the case for consideration in a clear, business-like form, and refers briefly in turn to the main points involved in such a scheme. He first touches upon the question of combining an electric plant with the present waterworks plant, and advises that in the case of Toronto this would not be economically feasible. He points out the caution which must be observed in accepting as correct, statements made of the operating cost of lighting plants owned by municipalities, owing to the doubt which must prevail, in absence of a detailed statement or an examination of their books, whether all proper charges have been included in the statement made, particularly a proper allowance for interest and depreciation. He instances points which would appear to make for the advantage of a new civic plant in competition with an older private company, viz:—The lower cost and better construction of electric appliances now than a few years ago, and the absence of any need for the city, after paying running expenses and an allowance for depreciation, to make a profit other than a low rate of interest on debentures, as compared with a dividend of about double such a rate required from a successful private company. He also alludes to the possibility of shortly obtaining power from Niagara Falls delivered in Toronto at a price to compete with steam. The plan he outlines for immediate lighting involves the addition of 300 arc lights, displacing the 1100 gas lights still remaining, making a total of 1300 arc lights—the station buildings to be large enough to ultimately contain a 1500 light plant, though at first a steam and electric plant for only 1300 lights is to be put in. On this basis a summarized estimate is given for buildings with station and street plant, totalling $310,200.00. Also a detailed estimate of annual operating expenses, including interest at 4 per cent., and depreciation at 6 per cent., reckoned on $310,200. The result shows an annual cost of $81.78 each for 1300 lamps, or $75.00 each for 1500 lamps, as against the present contract rate of $108.58 each for about 1000 lamps. The whole report is a straightforward statement, in sufficient detail to allow intelligent criticism. For instance, we miss from the annual operating expenses an allowance for contingencies not properly covered by the 6 per cent. depreciation, which might fairly be figured at 4 per cent. Last winter's sleet storm was an extraordinary contingency, but in different forms extraordinary contingencies are of practically annual occurrence. The present coal shortage is a case in point, and suits for damages will be always on hand. The report hardly shows a case favorable to city ownership, and it remains to be seen what the Electric Light Company can tender for the increased number of lights. The uncertainty about power from Niagara makes the present time unfavorable for determining on a large steam plant, when cheaper power may be available in less than a year.

R. C. BROWN GOES TO MONTREAL.

R. C. Brown, electrical engineer of the West End Street Railway of Boston, has resigned that office to accept a similar position with the Montreal, Canada, Electric Railway.

R. C. BROWN.

Mr. Brown ever since 1889 has been in the West End's service, and by dint of effort and native ability raised himself to the position of electrical engineer. His first position of trust was as superintendent of motors and cars, quickly followed by the superintendency of electric power, which he has since held to the satisfaction both of the company and of his employes. The best wishes of his many friends follow Mr. Brown to his northern field, and a rousing ovation from 100 of his employes marked his departure.—Street Railway Review.

THE ELECTRICAL STUDENT'S A B C.

A is the Amp, that went into the Arc.
B is the Brush, sometimes seen with a spark.
C is the Copper, most handy for mains.
D is the Dynamo, driven without reins.
E is the Science we study and pass in.
F is the Field, with more iron than grass in.
G is the Galvo., which "shorts" can foretell.
H Hysteresis, heats iron like —— (anything).
I is Induction, much blessed and cursed, too.
J is the Joule, set in carbon and cu.
K is the Kathode, who lives in a bath.
L is the Line, cut by wires in its path.
M is the Motor, which torques as it works.
N Non-conductor, which carrying shirks.
O is the Ohm, found in wire as in brick.
P is the Pole, which to iron wood stick.
Q is the Quickbreak on a high-voltage circ.
R the Rheostat, which 'eats when at work.
S is the Switch, like the ones used with trams.
T is the Telephone; earns many bad —— (words).
U is the Unit, at fourpence a blessing.
V is the Volt, who is always most pressing.
W the Watt; E. C., when you know it.
X the Xpense. House installers should blow it.
Y is the Yoke, which in magnets is grey.
And the
Z inc has connection with bells every day.

J. H. C. B., in London Electrical Engineer.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of the various Associations are requested to forward to us matter for publication in this Department not later than the 20th of each month.

ORGANIZATION OF WIARTON ASSOCIATION NO. 13.

Editor ELECTRICAL NEWS.

SIR,—On the 17th of May I had the pleasure of instituting Wiarton Association No. 13, C. A. S. E. with the following Bros. as officers: President, Wm. Craddock; Vice-president, Chas. Shaw; Rec. Secretary, Ed. Dunham, (engineer electric light station); Fin. Secretary, R. L. Graham; Treasurer, I. Dunham; Conductor, A. Sheldon; Door Keeper, R. Murray; Trustees, A. McLaren, G. L. Kitchen and Wm. Smith. The other members present were, Wm. McKenzie, Robt. Burrows, E. Drinkwater and D. McDonald.

Upon my arrival, I was met at the train by Bro. Ed. Dunham, and visited several of the members. In the evening we met in a very pleasant room, adjoining the Mechanics' Institute, and nicely fitted up by the members, with writing desk, black-board and everything necessary for good work. The members are all enthusiastic and anxious to learn, and I predict a strong useful and healthy little lodge in Wiarton.

After the meeting we adjourned to the Arlington, where an hour was spent very pleasantly, but as all had to be at work early in the morning and your humble servant was obliged to catch an inconveniently early train, we dispersed all well pleased and hoping to meet again.

A. M. WICKENS.

A branch of the C. A. S. E. is about to be organized at Peterboro', Ont.

WE learn from Mr. L. Brandon, Secretary, that the recently organized association of stationary engineers at Winnipeg, is meeting with gratifying success, additions to the membership taking place at every meeting. Mr. James White, engineer of the Ogilive Milling Co., has been elected president in the place of Mr. H. E. Robertson resigned. A deputation has been appointed to wait on the Government to request that incorporation be granted to the society. It is the intention to have a series of papers read at future meetings. The first of these will be prepared by the secretary, Mr. Brandon, his subject being "Heat as Pertaining to Boilers."

A regular meeting of the Ontario Association of Engineers was held at London on the 28th ult. The yearly message of the president, who was not able to be present, was read by the registrar. It showed this to be the most prosperous year since the incorporation of the association. The total number of certificates in force up to date, including raised certificates, amounts to 562; new certificates issued during the year, 161. The expenses for the year have been $523.95, leaving a balance in the treasurer's hands of $157.15. The four members of the board whose terms expired were re-elected, also the officers of the board.

PERSONAL.

Mr. D. A. Starr, electrical engineer, Montreal, is at present on a protracted business trip to the island of Trinadad, W. I.

We are pleased to learn that Mr. J. A. Kammerer, who for several years has successfully filled the position of District Agent at Toronto for the Royal Electric Co., has recently been appointed General Sales Agent for the Company, with headquarters in Montreal, vice Mr. D. A. Starr, resigned.

Mr. G. C. Mooring, chief engineer of the Methodist Publishing House, and an active member of Toronto No. 1 C.A.S.E., will sail on the 8th inst. from New York for England. He will be accompanied by his father. It is their intention to spend five or six weeks in revisiting associations and friends from which they have been separated during a residence of twenty years in Canada. Some of the leading engineering establishments will also be visited in quest of information.

TRADE NOTES.

Mr. Samuel May, President of the Dodge Wood Split Pulley Co., Toronto, is at present on a visit to Europe in the interest of the export branch of the Company's business.

As will be seen by reference to our advertising columns, Messrs. La Flamme & Anderson have started in business as electrical and supply engineers in Montreal. These gentlemen are thoroughly practical men in their profession and we feel sure that any contracts placed with them will be promptly and satisfactorily executed,

Messrs. John Starr Son & Co., of Halifax, call attention in our advertisement pages to the "Star" Incandescent Lamp of which they are the manufacturers. They inform us that they are selling large quantities of these lamps all over Canada as well as in the West Indies, South America, etc., and that they are giving excellent satisfaction. They have recently gotten up new and improved bases for these, which, together with other improvements, gives them high efficiency. The lamps are packed in such a manner as to add to the convenience of handling, each lamp being done up in a corrugated package, with particulars stated on outside. The Company also state that their "Unique" telephone is in increasing demand.

The Dodge Wood Split Pulley Co., of Toronto, have recently received from Mr. James Stuart, Superintendent of the Manitoba Electric and Gas Light Co., Winnipeg, the following letter through their Winnipeg agents, and which speaks for itself:—"In reply to your inquiry re Brown Friction Clutch, which we got from you about two years ago, I beg to state that it has been running a 50 arc light dynamo, of the Thomson Houston type, made by the Royal Electric Co., Montreal, and the clutch and pulley has given us perfect satisfaction. We are running clutch pulleys of different makes, but for ease of handling and perfect running, without slip of any kind, none of them can equal the "Brown" we got from you. In adding to our plant in future we intend to use no other."

QUESTIONS AND ANSWERS.

If the subscriber who writes to us for information over the nom de plume of "Ignoramus," will forward to us his name and address, as a guarantee of good faith, we will be pleased to endeavor to answer his enquiries.

SPARKS.

It is said that Battersea and Kingston will be connected by electric railway.

The New Westminster & Burrard Inlet Telephone Co. has been incorporated.

Messrs. Mackay & Guest, Renfrew, will shortly put in a 1,000 light incandescent machine.

The Dominion Parliament has granted incorporation to the Dominion Gas & Electric Co., Winnipeg.

St. Catharines has direct telephone communication with Detroit, 256 miles, the longest circuit in Canada.

The Sarnia Gas & Electric Light Co., have given a contract to the Canadian General Electric Co. for a new lighting equipment.

Application is being made for the incorporation of the Ontario Engine & Machine Co., of Toronto, with a capital stock of $12,000.

The annual meeting of shareholders of the Standard Electric Co., of Ottawa, will take place at the company's office on the 6th inst.

The Northwest Electric Co., of Winnipeg, are said to have decided to increase the motive power at their lighting station in the near future.

At a recent meeting of the Smiths Falls Electric Light Company, it was decided to buy a new dynamo and an entire set of lamps for the streets.

Negotiations are said to be in progress for the amalgamation of the interests of the Nanaimo electric light works and the proposed street railway enterprise.

The Packard Lamp Co., of Montreal, are negotiating for a suitable site on which to erect a new and commodious factory to meet the requirements of their rapidly growing business.

A chimney in the rear of the C. P. R. Telegraph office at Winnipeg collapsed on May 10th, killing Howard Smith, a check-clerk, and fatally injuring Aubrey Tennant, a message boy.

At the annual meeting of the Light, Heat & Power Co., of Kingston, Mr. R. T. Walkem was elected president, Mr. L. H. Breck, vice-president, and Mr. B. W. Folger, managing director.

The town of North Bay offers an exclusive franchise for a term of ten years to anyone putting in a system of electric lighting, the cost of public and private lights to be limited to a certain sum.

The Bell Telephone Company's Exchange, at Winnipeg, was recently damaged by fire to the extent of $5,000, as the result, it is said, of a telephone wire becoming crossed by an electric light wire.

The City Engineer of Toronto has received a communication from the Great Western Electric Manufacturing Co., of Chicago, stating that they are desirous of establishling a manufactory in Toronto.

The New Brunswick Telephone Co. are constructing a line from the C. P. R. station at East Florenceville to the village of Centreville, and will probably extend the line from thence to Hartland and Woodstock.

Mr Feodor Boas has obtained permission to erect poles, lay cables, etc., for the transmission of electric light and power at St. Hyacinthe, Que. He also contemplates engaging in the manufacture of electric plant and supplies.

There is said to be keen competition among the various electrical manufacturing companies for the supply of the necessary apparatus for an incandescent lighting system for the town of Orillia. Tenders closed on the 1st of June.

On the 6th of May, the power station and plant of the Nanaimo, B. C., Electric Light Co., was completely destroyed by fire. The company's loss amounts to about $50,000. We understand that a new plant will be installed as speedily as possible.

Messrs. Ross & Muir, who are at present erecting a flour mill at Mattawa, Ont., have expressed their willingness to install an electric arc and incandescent lighting pant at that place, if a sufficient amount of business is guaranteed to make the venture a profitable one.

In the item mentioning the incorporation of the "Packard Electric Co., Limited," at Montreal, which appeared in the May issue of the ELECTRICAL NEWS, the names of Messrs. F. E. Cavanagh and Charles C. Paige, were inadvertently omitted from the list of incorporators.

A bill introduced by Mr. Mulock has passed the Dominion Parliament providing for the placing of vestibules on electric street cars. This bill will no doubt be the means of raising the question of jurisdiction as between the Dominion and Provincial governments in relation to the control of electric railways.

The action of the Royal Electric Co. in appointing Mr. Fred. Thomson, who it will be remembered has a case pending against them in the courts, as their valuator for the adjustment of the loss sustained in connection with the recent fire on their premises, has excited a considerable amount of comment in electrical circles. Certainly no better testimonial of character could be given to Mr. Thomson than this.

Mr. E. O. Champagne, City Boiler Inspector for Montreal, in his annual report for 1893, just issued, shows that during the year he made 1,410 inspections, condemned nine boilers, found 89 boilers imperfect, and issued 313 test certificates. He also issued 413 certificates to persons in charge of engines and boilers, and 39 candidates failed to pass their examination. One accident had happened during the year, involving loss of life, and the owners of the insured boiler were condemned at the Coroner's inquest for negligence. Mr. Champagne advocates a return to the old system of compulsory inspection for all boilers.

Nowhere perhaps in Canada, has the introduction of the electric railway proved so injurous to the business of the hackman as at Ottawa, as the distance at which the railway depots are situated from the centre of the city made it almost necessary for persons arriving by train to engage the services of a hackman to convey them up town. Now the electric car stands alongside the station platform, and affords the traveller cheap and rapid transit wherever he may wish to go. It is rumored that a further inroad is to be made on the hackman's profits, by the extension of the street railway company's lines from Sussex street, through Rideau Hall grounds to the residence of the Governor General. The hackmen have petitioned the Governor General against the carrying out of the proposal. They claim that it would be an infringement on private rights to build a railway upon Government property.

SHAFTING. *

I need offer no apology for bringing a subject of this kind before an Association of Stationary Engineers, for wherever you find a stationary engine you will also find more or less shafting ; and if any other excuse were required it will be found in the fact that questions on shafting are quite frequently found in the Question Box at our meetings.

It may be, however, that there are some present who think that as engineers they are not expected to have anything to do with shafting. They may argue something like this : " Our employers expect too much from us; they look for us to wheel in coal, fire two or three boilers, wheel out the ashes, attend our engines and a score of other jobs, as well as find tools for the whole establishment ; and it would be just as well not to know anything about shafting, or we would be expected to attend to that too." In answer to such I would say, that it is not often that a man loses his situation by being too well posted, and in this world of changes one never knows when he may be called on to make use of the knowledge he possesses.

It is of the greatest importance that all shafting should be properly proportioned and correctly put up, as it not uncommonly happens that great loss of power and much annoyance results from carelessness or ignorance, and a plant that is otherwise of the best, rendered unsatisfactory.

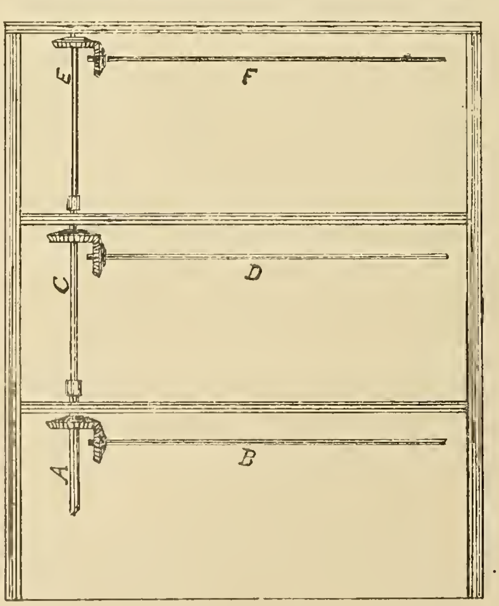
The first question the engineer has to decide is what size or strength of shaft he requires to do a certain amount of work, and in doing so he must bear in mind that a small increase in diameter will give a large increase in strength. It is not an uncommon thing to hear a man say that such a size ought to do the work, but to be on the safe side will put in a size larger, not knowing that he is adding a much larger factor of safety than be had any idea of. The strength of a shaft varies as the cube of its diameter varies. Let us assume that 1″ shaft will safely drive at a given speed four horse-power ; a 2″ shaft will drive as much more as the cube of its diameter in excess of the cube 1. The cube of 1″ is $1 \times 1 \times 1 = 1$. The cube 2″ is $2 \times 2 \times 2 = 8$. The cube of 3 is $3 \times 3 \times 3 = 27$ and the cube of 4 is $4 \times 4 \times 4 = 64$.

Now we assume that the 1″ shaft drives 4 H. P., the 2″ shaft drives as much more as the cube of its diameter is in excess of the cube 1 ; the cube of 2 is 8, therefore its power compared with the 1″ shaft driving 4 H. P., is $2 \times 2 \times 2 = 8 \times 4 = 32$ H. P., and comparing the 3″ shaft with the 1″, the cube of 3″ is 27 and the power of the 1″ is 4 H.P.—$4 \times 27 = 108$ H.P. It must be borne in mind that these figures are comparative and are given to show the rapid increase of strength in a small increase of size, for if we were to use a 3″ shaft instead of a 2″ we would have 108 H. P. instead of 32 H. P.

Another fact we must not lose sight of is, that the power a shaft will drive is in direct proportion to its speed. If a shaft drives 4 H. P. at 100 revolutions per minute, at 200 revolutions it will drive 8, and at 300 it will drive 12 H. P. The higher the speed of the shaft the smaller the diameter of the shaft to drive a given H. P. Then there is another important consideration in selecting a proper size for a shaft—as they are inclined to bend and also to twist we must take into account the weight of the pulleys and the distance they are from the bearings and whether the strain of the belts is down or the reverse. The bending of a shaft as well as the torsion contributes towards its liability to break, but the bending is the most likely to cause it. The bending also causes a considerable loss in power as well as a the liability of belts running to one side of the pulleys. It follows therefore a shaft loaded with pulleys must have a greater number of bearings and the pulleys placed as near the bearings as possible..

To put up a larger line of shafting than is necessary, is objectionable for two reasons ; 1st it costs more to put it up ; and 2nd it costs more to run it after it is up. The extra weight of the long shaft as well as the larger circumference which has to move through a greater distance will add materially to the friction. There is one other fact I would notice before leaving this part of the subject, and that is, that the second and third lines may be smaller than the main driver. The reason of this obvious, for the first line has not only its own machinery to drive but also the second and third lines with the machinery driven from them.

To make this clear, I have prepared a diagram which I believe will make it plain to everyone. We will call it a mill or factory, and we assume that the machinery in it requires 100 H. P. to drive. The machinery on the first floor requires 45 H. P., that on the second, 30 H. P., and on the third, 25 H. P. Now the shaft A and B are practically one shaft, being coupled together by the gear; so are C and D, and E and F ; but while practically one shaft, A has to transmit 100 H. P., while B only transmits 45 H. P., therefore B may be smaller than A. B having absorbed 45 H. P., it follows that C has only to transmit 55 H. P., therefore C may be smaller than A. The machinery on the first and second floors has now absorbed 75 H. P., leaving only 25 H. P. for the third floor, therefore the shaft E and F may be smaller than C.



The same argument will hold good with the shafts B, D, and F. If the machinery which they drive was equally distributed from end to end, then the ends furthest from the motive power might be smaller because they would have less power to transmit, but in practice the disadvantage would be greater than any gain that would be derived from so doing.

I will now give one or two rules to determine the size required to drive a given H. P.

To find the power a shaft will transmit, cube the diameter and multiply by the number of revolutions per minute, and by two, if it is the first line from the engine, and by three if it is the second, and divide by 100.

The crank shaft being the first or prime mover. what power will a 2″ shaft transmit as a second mover running at 300 revolutions per minute ? $2 \times 2 \times 2 = 8 \times 300 = 2400 \times 2 = 4.800 \div 100 = 48$ H. P. If steel add 30 per cent. If this shaft was to be used as a second line then it would be : $2 \times 2 \times 2 = 8 \times 300 = 2400 \times 3 = 7.2'00 \div 100 = 72$ H. P. Where the power required is known and number of revolutions is given and the size of shaft is wanted, proceed as follows : What diameter of shaft is required as a prime mover to transmit 75 H, P, at 175 revolutions? $75 \times 100 = 7.500 \div 175 = 42.86 \div 2 = 21.43$. The cube root of 21.43 is 2.75, (2.7776) the diameter required.

The same problem with the shaft used as a second line, would be : $75 \times 100 = 7.500 \div 175 = 42.86 \div 3 = 14.28$. The cube root of 14.28 is 2.42 (2.4261) the diameter required.

Having got the size we want, the next thing is to get it put up, and it is right here where many failures and mistakes are made. There is perhaps no part of the plan which should be more carefully looked after than the proper lining of the shafting because it is a never-ending source of annoyance if out of line. The rules governing the putting up of shafting are few and very simple :

1st, Be sure that your shaft is exactly at right angles with the engine pulley ; 2nd, see that it is dead level ; and 3rd, be sure that it is as straight as a line can make it. The same rules should be observed with intermediate and counter-shafts, they must be parallel with main shaft. All shafts carrying pulleys must be level ; a shaft driven with gear from a horizontal shaft must be at right angles with it but may be run at any angle from the horizontal, and the same if driven from a perpendicular—in this case the driven shaft must be level, but may be run in any direction. If the building is likely to settle the adjustable hanger should be used, but where there is no danger of settling, stationary bearings should be used, especially for dynamos and all heavy machinery which ought to be a rigid as possible.

I do not think it advisable to give any rule for the distance at which bearings should be set, as circumstances vary in almost every case, but would state that for a a 3″ shaft the distance should never be more than 15 feet, and for a 2″shaft not more than 11 or 12 feet. These distances in both cases are for shafts without pulleys.

We have stated that second and third lines of shafting may be smaller than the first, but this applies only where they run at the same or at higher speed, and does not apply where the speed is reduced for the purpose of driving heavy and slow speed machinery or lifting heavy weights. Let us try to make it plain. Let us assume we have a weight of 33,000 lbs. to lift and a one H. P. engine to lift it with ; we can raise the weight one foot high in one minute, but if our weight is ten times as heavy, or 330,000 lbs., it is evident that to lift this with the same engine it can only be done by a sacrifice of time, or in other words a reduction of speed (bear in mind that to lift a weight greater than the motive power can only be done at a sacrifice of time). Now what are we going to do? Our weight is 330,000 lbs., and our engine is only 1-10th the power required to lift it. It is evident we must construct a system of reducing gear. We will assume that we require three reductions—the first reduction will be from the engine to the first shaft, and so on until we reach the third or last shaft which supports the weight. Now the nearer we get to the weight the stronger must the shafting be, and the same with the gear, because as each shaft is reduced in speed it is capable of transmitting less power, and therefore must be increased in size.

Precisely the same principle is clearly shown in the use of the lever—a man can lift a heavy weight with a lever, but it is always at a sacrifice of time or speed. It is also well understood that the end of the lever on which the man rests may be very much smaller than the end which rests on the fulcrum, because on it rests the whole weight.

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[*] Paper read before Toronto No. 1, C. A. S. E. by Bro. Geo. Gilchrist.

MOONLIGHT SCHEDULE FOR JUNE.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	
1......	P. M. 7.50	A. M. 3.40	7.50
2......	" 7.50	" 3.40	7.50
3......	" 7.50	" 3.40	7.50
4......	" 7.50	" 3.40	7.50
5......	" 7.50	" 3.40	7.50
6......	" 8.50	" 3.40	6.50
7......	" 9.40	" 3.40	6.00
8	" 10.20	" 3.40	5.20
9......	" 11.00	" 3.40	4.40
10......	" 11.20	" 3.40	4.20
11......	" 11.50	....	3.50
12......	....	" 3.40	
13......	A.M. 12.20	" 3.40	3.20
14......	" 1.00	" 3.40	2.40
15......	" 1.20	" 3.40	2.20
16......	" 1.50	" 3.40	1.50
17......	No light.	No light.	....
18......	No light.	No light.	....
19......	No light.	No light.	....
20	P. M. 8.00	P. M. 10.10	2.10
21......	" 8.00	" 10.50	2.50
22......	" 8.00	" 11.20	3.20
23......	" 8.00	" 12.00	4.00
24......	" 8.00	A. M. 1.00	5.00
25......	" 8.00	" 1.20	5.20
26......	" 8.00	" 1.40	5.40
27......	" 8.00	" 2.10	6.10
28......	" 8.00	" 2.40	6.40
29	" 8.00	" 3.20	7.20
30......	" 8.00	" 3.40	7.40
		Total,	136.30

RELATIVE ADVANTAGES OF TOOTHED AND SMOOTH CORE ARMATURES.*

By Alton D. Adams.

THE merits of different methods of construction in the manufacture of dynamo electric machinery, as in other lines, must evidently be decided by their comparative costs, all else being equal. Although questions concerning the relative merits of toothed and smooth core armatures have long been discussed, very little seems to have been written, to show whether actual saving in cost may be effected by one construction over the other, when employed to produce the same results.

The practice of dynamo builders in this country, and abroad, embodies both types, and the history of the art records many changes from each to the other. In view of the above, the inquiry, whether in the light of present facts any saving can be effected by the use of toothed core armatures, seems of interest.

The limits of this paper do not permit consideration of this question in connection with all classes of electrical machinery, and its bearing on direct current constant pressure machines only will be taken up.

The principal disadvantages of toothed, compared with smooth core armatures, are greater first cost, large change of lead, excessive sparking when used with too short air gaps, and the production of heat in pole-pieces; their advantages are, that inductors are positively driven, large solid inductors, protected from eddy currents, and that a reduction may be made in the length and consequent magnetic resistance of the air gap.

Change of lead may be fixed within any desired limits, and sparking abated by such proportions of air gap and teeth, as give them sufficient magnetic resistance.

Heat in pole pieces may be reduced by their lamination, by the use of very narrow teeth and slots, by forms of teeth that present a nearly continuous surface of iron to the pole pieces, and still more, by the use of openings in core discs which do not cut through their outside surface, or a continuous magnetic sheath outside the teeth.

For any given form of tooth, the heating of pole pieces is less, the longer the air gap.

The mechanical strength of armature teeth, as usually employed, is far in excess of that required to hold inductors in position, even under conditions of short circuit, and driving pins inserted in the core, at proper intervals, are much cheaper and take up less valuable room on the armature circumference.

Either teeth or substantial driving pins are, of course, preferable mechanically to the slender bits of hard fibre which have been much used, and frequently give way under the heavy strains to which large generators are subject.

When large wires or copper rods are used as inductors, their protection from eddy currents is an important matter, but proper stranding of inductors reduces the eddy loss in them, when used on smooth cores, to a very small amount, and has the further important advantage that inductors may be bent into the proper shape at armature ends, and the joints, necessary when rods are used, avoided.

The chief possible advantage, then, to be gained by the use of toothed armatures, is through a reduction in the length of the air gap, and the consequent reduction in the ampere turns required on field magnet, weight of copper, or energy in winding, and the length and weight of iron core. To make this advantage available, it must be practical to use air gaps shorter than are required for insulation, winding and clearance.

As is well understood, the armature winding of a dynamo or motor, in operation, has a magnetizing action which is measured in ampere turns for a bipolar machine, by one quarter the product of all the inductors of the armature, into the total armature current. The ampere turns on the armature evidently tend to set up a flow of magnetism, having a complete circuit through the armature core, twice across each air gap, and through the iron of pole pieces.

About half the ampere turns furnished by the inductors under pole pieces, evidently act against the field ampere turns in each air gap at the polar tips, and the ratio between the armature and field ampere turns at this point, necessary to give sparkless reversal there, must determine whether the required magnetic resistance be greater or less than that of an air gap long enough for insulation, winding, and clearance with a smooth core armature.

As an armature coil in an operating dynamo or motor passes under the brush, the current flowing in it must stop, and one in the opposite direction be set up; and if this action is to be accomplished without sparking, a sufficient electromotive force must be provided in the coil while in direct contact with the brush. In the ordinary dynamo or motor, magnetism forced across the path of the coil, by the field ampere turns expended in air gap, must provide this reversing electromotive force.

The data of a number of smooth core armature machines of different make, show ratios of field to armature ampere turns in air gap, of from about one and one-half to one, to two and one-half to one, and the writer's experience is that a ratio of two to one will give sparkless operation at full load, with brushes set just outside pole corners.

It is a matter of common experience that the ratio between field and armature ampere turns in the air gap may be so reduced, even in machines with smooth core armatures, as to require excessive change of lead to secure even approximate freedom from sparking.

If it be desired therefore to build machines having an expenditure of field ampere turns in the air gap not much greater than those of the armature, we need not resort to toothed cores.

Take, for example, the case of a 260 ampere dynamo, with 120 inductors on its armature in one layer; an air gap induction of 25,000 lines per square inch, and 80 per cent. of inductors under the pole pieces.

An air gap of .45 inch between the armature and each pole piece will be sufficient for insulation, winding and clearance, and the field ampere turns expended in each air gap will therefore be 3,500, while the armature ampere turns, active under each pole tip, will be 3,100.

A considerable change of lead and sparking can be readily predicted for this machine.

In some types of small machines, the room required for insulation, winding and clearance, makes the air gap longer than necessary for sparkless operation, and in such machines the utility of teeth seems to depend on their cost compared with the saving to be effected by their use.

As the ampere turns, furnished by the inductors under any pole piece, grow less in a machine of given capacity when the number of poles is increased, very short air gaps may be used, if the number of poles is sufficiently large.

As an increase in the number of poles usually makes a machine of given capacity more expensive, however, the question at once comes up, to what extent the number of poles may be increased without a greater expenditure than the saving of iron and copper to be effected.

In large multipolar machines of four or six poles, such as are commonly used, the length of air gap required for sparkless operation, is considerable, and those who have watched the development of these machines with toothed core armatures during the last four or five years, have seen the air gaps gradually widen until machines of this character are not hard to find in which the copper inductors between the teeth could be taken out, wound outside the teeth, and still leave room enough for good clearance.

Additional mechanical security, of course, furnishes a considerable argument for the use of teeth in large slow speed machines.

A number of devices have been suggested from time to time, to enable toothed core armatures to be used with short air gaps, and the consequent saving in iron and copper effected. No machines with these devices, however, have yet stood the test of time and competition with those of ordinary type, and have yet to prove their ability to produce results, as at present attained at a less cost.

The seeming opportunity to save material by the use of toothed armatures is very attractive, and we cannot but hope it may some day be practical; in the light of present knowledge, however, there seems little to be gained by their use in medium or large bipolar machines.

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*A paper read at the Phila. Meeting, Am. Inst. Elec. Engrs., May 16, 1894.

SPLIT PULLEYS.

HAS it ever occurred to you, says J. A. Allen in the Iron Trade Review, that there are some methods coming into vogue that are cheaper in the long run to use than to be without? Among these is the split pulley. It costs money, and big money, too, at times to cut a keyway in a shaft when a new pulley is to be located. Have you ever used a good split pulley? If not, do so. A short time since I fitted out a whole shop with pulleys and shafting, and used nothing but split wooden pulleys. Hold? Well, not at first. Each pulley was tightened as well as we could do the work at the start and then watched. At the first indication of a slip the wrench was put on again and that settled the matter for all time. I had those pulleys driving every conceivable kind of ironworking tool, from a light drill to a heavy hammer, and never had the slightest indication of trouble. Then, when new tools were bought and old ones had to be shifted, ten minutes sufficed to take down the pulley. But when I did that job, I didn't know as much as I do now. I allowed builders to sell me tight and loose pulleys on the countershafting, so that for every machine having a four-inch belt I had to buy a nine-inch split pulley. If I had the job to do again I would specify clutches. Of course the clutch would cost more than the extra paid for the double width split, and the additional loose pulley, but not so very much. And then I would save weight on my main line; and room also.

TRADE PAPERS AS AN ADVERTISING MEDIUM.

THERE are scores of business men, says the Journal of Building, who, when told that the circulation of a trade paper is 3,000 to 4,000, are inclined to ridicule its claims as an advertising medium, not knowing that a single edition of a trade paper, a circulation of 1,000 copies, reaches more persons whom they wish to reach than the issue of a daily paper of 100,000 copies. Those who may be surprised at this statement and imagine that the figures are incorrect may easily convince themselves of their error by referring to the commercial agency reports. To reach the consumer of general merchandise the daily papers are a valuable medium; to reach those particularly interested in trade, the trade papers alone cover the field.

ELECTRIC RAILWAY DEPARTMENT.

DESTRUCTIVE EFFECTS OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.

In a paper on the above subject read before the American Institute of Electrical Engineers, Mr. Isaiah H. Farnham describes some experiments made in Boston, with the effect of discovering means to avoid damaging effects by electric currents employed for street railway purposes upon underground pipes. The facts elicited by these and other experiments have led Mr. Farnham to the following conclusions:

1. All single trolley railways employing the rails as a portion of the circuit, cause electrolytic action and consequent corrosion of pipes in their immediate vicinity, unless special provision is made to prevent it.
2. A fraction of a volt difference of potential between pipes and the damp earth surrounding them is sufficient to induce the action.
3. Bonding of rails, or providing a metallic return conductor equal in sectional area and conductivity to the outgoing wires, is insufficient to wholly prevent damage to pipes.
4. Insulating sufficiently to prevent the trouble is impracticable.
5. Breaking the metallic continuity of pipes at sufficiently frequent intervals, is impracticable.
6. It is advisable to connect the positive pole of the dynamo to the trolley lines.
7. A large conductor extending from the grounded side of the dynamo, entirely through the danger territory and connected at every few hundred feet to such pipes as are in danger, will usually ensure their protection.
8. It is better to use a separate conductor for each set of pipes to be protected.
9. Connection only at the power station, to water or to gas pipes, will not ensure their safety.
10. Connection between the pipes and rail, or rail return wires, outside of the danger district, should be carefully avoided.
11. Frequent voltage measurements between pipes and earth should be obtained, and such changes in return conductors made as the measurements indicate.

THE ELECTRIC LOCOMOTIVE.

There is special reason why the mechanical engineer may be expected to increase his efforts in connection with the steam locomotive, says the Railway World, for he is likely soon to feel the stimulus of wholesome competition. Already the electrical engineer has his visions of a high speed locomotive and is preparing to challenge the position of the steam locomotive. So far has he already progressed that many mechanical engineers—and among them may be found the locomotive superintendents of not a few important railways—are keeping in view the possibility of radical changes in their department, and, while perfecting their own machines, keep, as it were, an eye to windward. Moreover, there is no objection to the material increase of speed on the grounds of safety, for in England especially the permanent way is well-nigh perfect, and fully capable of permitting almost any speed obtainable. Altogether, there is no reason to expect that development toward higher speed has reached a limit, while there are many considerations which point to rapid improvements in this direction.

SPARKS.

The extension of the Toronto and Scarboro Railway to Victoria Park has been completed.

The Montreal Street Railway Co. are said to have made a net profit during the six winter months, of $59,000.

The Standard Light & Power Co. is said to have decided upon the construction of an electric railway, from the city of Montreal to Lachine.

Eight thousand passengers were carried over the Kingston Electric Railway on the Queen's birthday.

An action for $10,000 damages has been brought against the town of Port Arthur, by a person named Burk, who lost his hand by an accident on the Port Arthur Railway, of which the town of Port Arthur is the owner.

A considerable amount of new machinery, including a 200 H. P. Robb-Armstrong engine, has lately been added to the plant of the Sandwich, Windsor & Amherstburg Railway.

It is proposed to utilize power from the cable station at Canso, N. S., for the operation of an electric railway from Hazel Hill to Canso, a distance of three miles, and from Milton to Liverpool, a distance of six miles.

Mr. John Patterson, the principal promoter of the Hamilton Radial Electric Railway, is said to have succeeded in making the necessary financial arrangements for the carrying out of the undertaking.

The city council of Toronto will contract with the Toronto Railway Co. to water, four times a day, the track allowance, covering a distance of forty miles, at a cost of $26.00 a day.

Mr. McKenzie, of the Toronto Railway Co., who is at present in the Northwest, is reported to be negotiating on behalf of the Dominion Lighting Co. for the purchase of the Manitoba Gas and Electric Company's property and the Street railway controlled by Mr. Austin.

The courts of Montreal have given judgment against the Montreal Street Railway Co. for $5,325, in favor of Mrs. J. H. Hamelin. The plaintiff's husband was run over by one of the company's horse cars, and died from the result of the amputation of one of his legs which had been injured in the accident.

Messrs. A. H. Edwards and James Fowler, of Carleton Place, are among the promoters of a company which is endeavoring to secure aid from the municipalities for the construction of an electric railway from Perth to Lanark, Ont.

The Niagara Falls Park & River Railway Co. have paid $10,000 to the Victoria Park Commissioners for the privilege of constructing an incline railway at an angle of fifty degrees from the top of the bank at the southwest corner of the Clifton House to the Maid of the Mist Landing. It is said to be the intention to charge a twenty-five cent. fare.

The Town Council of Oshawa have given the right of way for an electric railway to Capt. Carter, of Deseronto. The railway will be built in three sections, and will run from the Grand Trunk depot through the town, with switches to the leading manufacturing concerns. A bonus of $1,500 on sections one and two, and of $2,000 on section three, is a condition of the agreement.

A company is said to have been formed with the object of constructing an electric railway at Nanaimo, B. C., with an extension to the adjoining town of Wellington. The road will be about ten miles in length, and it is said to be the intention of the promoters to make the construction and equipment of first-class character. The road is expected to be in operation by the 1st of September.

It is reported to be the intention of Mr. F. W. Colcleugh, of Selkirk, to commence immediately the construction of an electric railway from Winnipeg to Selkirk, for which he holds the charter. It is probable that the construction of the road will be done by contract with the Winnipeg Street Railway Co., but should this not prove to be the case, it is said that Duluth capital will be forthcoming to complete the undertaking.

Application is being made for the incorporation of "La Compagnie de Tramways Electriques de Quebec," for the construction of an electric street railway in the city of Quebec and through the suburbs of St. Valier, St. Sauveur, Jacques Cartier, St. Roch, etc. The promotors of the company, are Messrs. J. B. Laliberte, J. U. Gregory, B. Leonard, P. Dumoulin, J. F. Guay and F. M. W. Pampalon. The capital stock is to be $200,000.

The construction of the Hamilton, Beamsville & Grimsby Electric Railway is being pushed forward in a most active manner. Thirteen miles of track have been completed, leaving only four miles at the Grimsby end of the line to be finished. The power station is well-nigh completed, and the cars for the equipment of the road about ready for shipment. The company are unfortunately still experiencing difficulty with one or two of the municipalities regarding the right of way.

The City Council of Hull has granted the application for a charter by Mr. D. Viau, on behalf of a local company, for the construction of an electric railway in that city. The period of the charter is thirty-five years. It provides for exemption from taxes for fifteen years, for the commencement of the work within two years, and for the expenditure of $15,000 thereon the first year, and $5,000 a year for the succeeding ten years. The corporation has the right to purchase the road and equipment at a price to be fixed by arbitration, after the expiration of twenty years.

In reply to an inquiry, Sir Adolphe Caron stated in the House of Commons recently that the contract made with the Ottawa Street Railway Co. for carrying the mails from the railway stations to the post office had proved to be in every way preferable to the former system by mail carts. The contract is for a period of four years from 1st November, 1893, at the price of $4,000 per year, which is slightly more than $100.00 above the cost of the old method. It is understood that the Government has under consideration proposals from the Montreal and Toronto Street Railway Companies for a like service in those cities.

It is reported to be the intention of the Toronto Railway Co. to extend their Mimico line to Burlington, and there make connection with a branch of the Hamilton Radial Electric Railway, thus providing through electric transit between Toronto and Hamilton. It is said to be the intention to equip the line for passenger and freight traffic, and in the case of the former, to give a half-hour service with a speed of twenty miles an hour, and about half the price charged by the G. T. R. The opinion is expressed in some quarters that the C. P. R. Co. are at the back of this project, with the object of obtaining, free of charge, right of way between Hamilton and Toronto.

Section 210 of a bylaw of the city of Montreal for the regulation of the street railway reads as follows :—"The company shall not carry more passengers than the cars can conveniently accommodate, and the number of passengers each car can accommodate shall be previously fixed and determined by the City Surveyor, and indicated upon a card posted inside and outside of each car." The City Surveyor has decided that an ordinary horse car can hold from twenty-four to thirty-four passengers, open cars from thirty-five to fifty, and motor cars from thirty-six to thirty-nine. He lately instructed the clerk of the Recorder's Court to take legal proceedings against the Street Railway Co. for overcrowding their cars, but the case was dismissed.

Mr. Thos. Todd, president of the Galt & Preston Street Railway Co., stated at a recent meeting of the directors, that the contract for dynamos, motor cars, overhead work, bolting rails, etc., had been awarded to Messrs. Ahearn & Soper, of Ottawa, at the sum of $15,925, and the contract for engines and boilers to the Goldie & McCulloch Co., of Galt, at $6,000. He stated further that the rails, ties, posts and spikes and three trailer cars had been purchased by the Directors, and that the only remaining contracts to be let are the erection of a power house and the bridge over the Speed, tenders for which are already in. The road is expected to be in running order by the 1st of July. The cost of the road, including equipment, it is said will not exceed $75,000.

The construction of an electric railway, connecting the towns of St. Stephen N. B., and Calais, Me., has been commenced by Mr. C. A. Richardson, President of the Worcester, Mass., Construction Company. The road will be seven miles in length, extending from the steamboat landing at Calais through the principal streets of the town, and crossing to St. Stephens by means of the two bridges across the St. Croix. The road will be equipped with ten cars, each car being capable of accommodating fifty passengers. The company propose, also, to supply electric light and power. The power station is to be of brick, thirty-five by forty feet in size, with a chimney seventy feet in height. The car sheds will be thirty-five by fifty feet in size, built of wood. A one hundred and fifty h. p. Ball engine will furnish the motive power to the generating machines, which will be of the Westinghouse type. The officers of the company, which has a paid up capital stock of $100,000, are as follows: Mr. I. C. Libby, of Waterville, Me., treasurer; Mr. H. A. Goodenough, of Brighton, Mass., president; Mr. Curran, a lawyer of Calais, Me., secretary; Messrs Pike and Hill, of Calais, and Mr. Richardson, directors.

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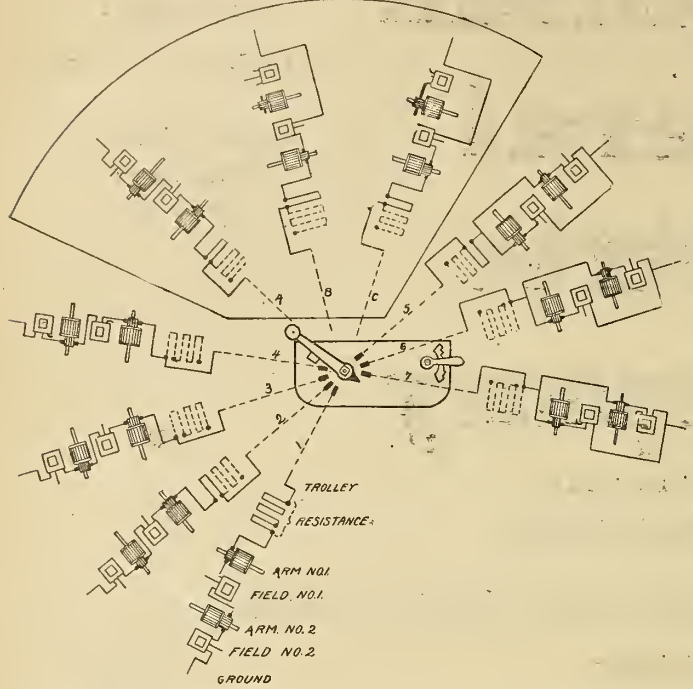
THE proper handling of the controller is the most important point in a motorman's education, and it is almost impossible to train a man to handle the controller properly unless he understands the principles of what is going on and the connections that are being made as the handle is thrown from point to point.



Educating a large number of motormen who have had no previous knowledge of electricity is a difficult task at its best, and anything to simplify matters ought to be gladly adopted. The accompanying illustration is from a blue print which is supplied to every motorman on the Calumet system of this city. On the same sheet are a few instructions and a brief explanation of the connections. The idea of the diagram, as will be seen, is to give the connections for each controller point in the same relative positions as those taken by the controller handle in making the corresponding connections. This particular diagram is for the General Electric type "K" controller wired to W. P. motors and using the field loop method of control. Of course the idea is applicable to any controller. With plain reheostat control such diagrams would not be worth the while, but where the connections are as numerous and varied as on series-parallel controllers, anything that will simplify matters to the befuddled mind of the motorman during the learning period, should be adopted. The department on the Calumet system is under the charge of H. P. Rustling, who is doing much to save repairs by a thorough education of the men under him.

ALLGEMEINE ELEKTRICITATS-GESELLSCHAFT.

WE learn from our Montreal correspondent that Messrs Munderloh & Co., Montreal, have secured the sole agency for the Dominion of Canada, for the Allgemeine Electricitats–Gesellschaft (General Electric Company of Berlin, Germany.) The well known quality of the goods of this firm throughout Europe and the United States should secure Messrs Munderloh & Co. a portion of the trade in this country.

The exhibit of the Company at the World's Fair was highly praised by many of the leading American electricians and engineers, it being one of the largest and finest in the Electricity building.

The introduction of electric street railways on the continent of Europe is due chiefly to the Allgemeine Elektricitats–Gesellschaft, who have carried out by far the greatest number of trolley systems in towns. Where sharp curves occur a special arrangement of the overhead wiring is provided for obtaining the greatest possible smoothness in running; this is effected by a suitably shaped instrument, facilitating the speedy fixing and removal of the span-wires between the curves. The Allgemeine Elektricitats–Gesellschoft were the contractors for the transmission of power from Lauffen to Frankfort.

Mr. John A. Burns has been appointed manager of the electrical and mechanical department of Messrs Munderloh & Co., and inquiries for goods for which he has the agency should be addressed to Munderloh & Co.

The City Engineer, of Hamilton, is considering the advisability of manufacturing electric light for the pumping-house at Burlington Beach, on the premises as is done at the pumping station at Toronto.

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USEFUL HINTS.

Never open the shunt circuit of a generator (or mortor) while it is charged, as the inductive discharge from its fine winding is liable to strain the insulation and sometimes destroy it. In the case of a motor, and the winding remaining intact, the motor will race and the abnormal flow of current may burn out the armature.

A Good Soldering Fluid.—In order that all joints should be perfectly secure it is necessary to solder them, and in this work nothing but an acid solution much recommended is easily made and simple, as given below. After the joint is complete, the acid should be washed off before applying the tape:—Saturated solution of zinc, 5 parts; alcohol, 4 parts; glycerine, 1 part.

The best economy yet reported for a triple expansion engine is 12.73 pounds of feed water per hour per horse power. This has been satisfactorily shown by a Sulzer Corliss engine in Germany with cylinders 19.65 in. 26.4 in. and 47.35 in, by 55.2 in. stroke at 65.5 revolutions per minute, 145 pounds boiler pressure and about 24 expansions with all cylinders and receivers jacketed with live steam as boiler pressure.—Power and Transmission.

In piping up a boiler the stop valve in the main supply pipe should be so placed that water cannot collect about the valve. This is liable to occur where a globe valve is used and placed in the horizontal main in an upright position, or in the vertical main. In either of these cases a drip should be provided, but a much better plan is to place the valve in a horizontal position, or else use an angle valve. Where water can collect trouble is sure to come, from water-hammer breaking connections.

In case an armature should get wet while in transit or from other causes, it should be thoroughly dried out before being run, and this says the American Mechanic can readily be done in several ways. Where ovens are handy, as in factories, they are used for this purpose, and a slow steady heating will do the work, taking care not to have it too hot. In central stations, where there is no oven, they very often turn a current from another machine through the armature, having a meter in circuit so as to avoid too much current of the armature. This will probably be found the best way in most cases and thoroughly dries the armature, as the current passes through it very thoroughly.

Twenty centuries before the birth of Watt a mechanic of Alexandria described machines whose motive power was steam, and even anticipated our modern turbine wheel by a machine he named "Neopile." When Fulton launched the Clermont he was simply repeating what was done in the harbor of Barcelona as far back as 1543. We have no parental claim on electric discovery, for in the twelfth century the scientific priests of Etruria drew lightning from the clouds, antedating Franklin, and by the means of an iron rod on the shores of the Adriatic Sea the signal service electrician of ancient days released the electric spark by means of the coming storm.

SPARKS.

A local paper claims that the town of Seaforth now has the best equipped telephone office west of Toronto.

Messrs. Laurie Bros., engine builders, Montreal, are applying for incorporation under the name of The Laurie Engine Co. with a capital of $250,000. The enlargement of their works is contemplated.

The Toronto Railway Co., have given assurance to the City Engineer of Toronto, that they are willing to lay all the electric return wires necessary to prevent the possibility of underground water mains and other pipes being damaged by electrolytic action.

Mr. Frederic Nicholls, manager of the Canadian General Electric Co., when asked by a representative of The Electrical News the other day regarding business conditions, expressed himself as being agreeably surprised to find that there is no falling off in the electrical business, while in other lines of wholesale business there has been a shrinkage of 25 to 30 per cent. The opinion obtains that as soon as the business depression at present prevailing begins to clear away, there will be witnessed a period of great activity in electrical business in this country, more particularly in the line of electric railway extension.

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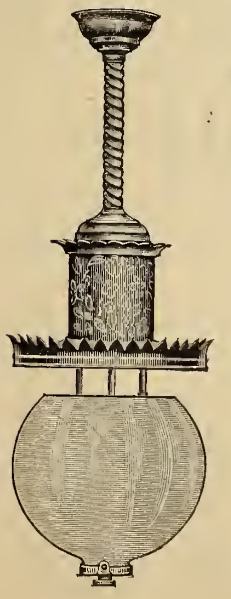

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NON-MAGNETIC

... FOR ...

Direct-Incandescent or Alternating Circuits.

IT IS WITHOUT A COMPETITOR ON ALL CIRCUITS SINGLY OR IN SERIES.

It is not affected by the flashing of machine.

IT CAN BE REPAIRED BY ANY ONE.

It is much more reliable in action and would save the cost of patrolmen.

The energy expended on the electro magnets' mechanism to operate most arc lamps is utilized in THE EXACT to enhance its candle power. Its resistance is lower than any other lamp.

By using this lamp all the requirements of a city for power arc and incandescent lighting may be met by an alternating plant, thereby saving cost of direct generators, engines, shafting line construction and maintenance of same, thus reducing the cost of installing and maintenance nearly fifty per cent.

One lamp can be burned on a 5 light transformer and from 25 volts up.

To Electric Lighting Companies—It will pay you to destroy your lamps and purchase direct from us. . . . .

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under the W. E. Irish Patents.

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John St. North, HAMILTON, ONT.
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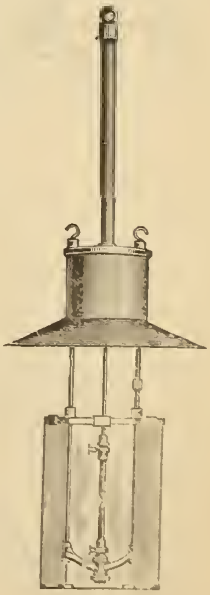

For street lighting.

SPARKS.

Messrs F. H. Sleeper & Co. have commenced the manufacture of electrical machinery at Coaticook, Que.

The Town Council of Tilbury Centre, Ont., are reported to have decided upon the purchase of an electric light plant.

Messrs. Geo. H. Harper & Co, are erecting poles and stringing wire for electric light and power for commercial purposes at Dundas, Ont.

It is reported that some citizens of St. John, N. B., are endeavoring to form a company to install an electric lighting plant at St. George, N. B.

The City Council of Calgary will shortly submit to the ratepayers a by-law authorizing the expenditure of $30,000 for the purchase of an electric light plant.

A Mr. Cone has recently visited the town of Parry Sound, with the view of forming an Electric Light Co., and also establishing a machine shop for the manufacture of electrical apparatus.

Incorporation has been granted the Woodstock and Canterbury Telephone Co., of New Brunswick, to build and operate a telephone line between Woodstock and Canterbury.

Permission is being sought by the Standard Electric Power Co. to run electric cars through Cote St. Antoine and Notre Dame de Grace, and to enter the city of Montreal by way of Dorchester street.

Suits have been entered against the Montreal Street Railway Co. by the Bell and Federal Telephone companies for compensation for the use of their poles and to restrain the defendants from using the poles in the future.

It is said that in view of the fact that only one company has tendered for the contract for street lighting at London, Ont., it is in contemplation to organize a joint stock company of local business men to tender for the franchise.

The Water and Light Committee of the Goderich Town Council, recommend consideration by the Council of the application of the Wingham Electric Light Co. for permission to install an incandescent electric lighting plant.

The Plate Glass & Boiler Insurance Co., of London, Ont., are reported to be about to institute open meetings at which lectures on economy in engineering will be delivered for the benefit of operative engineers, and owners of steam plant.

The following students of electricity at the Toronto Technical School were granted certificates of proficiency at the recent examinations: J. W. Lawson, S. S. Clarke, J. R. Jeffrey, J. R. Patterson, A. Coulter, H. C. Champ, J. Preston, B. Kirk, A. L. Torgis, Geo. Adams, J. D. Adams, W. Hahn, Geo. Trimming, H. F. Hutchison.

The Royal Electric Co., of Montreal, must be regarded as having been unfortunate of late. Following close upon the destruction of their incandescent lighting station, came the explosion of a boiler in their east end lighting station, wrecking the boiler house, but fortunately doing little damage to the machinery. It is still more fortunate that no injury was done to any of the employees at the station, or to the crowd of people who were at the time congregated in Sohmer Park, which immediately adjoins the lighting station. As the result of the accident, the electric lights throughout the city were temporarily extinguished, but in a very little time seven circuits were put on from the Wellington street Station.

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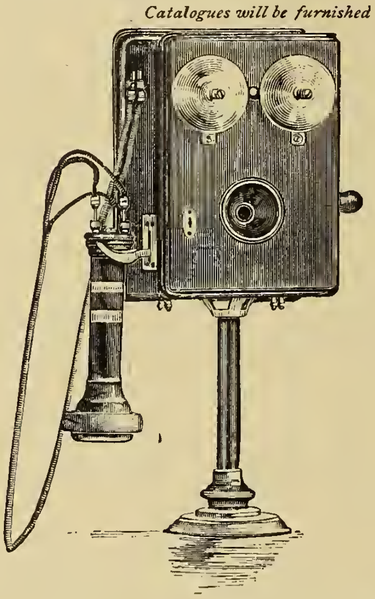

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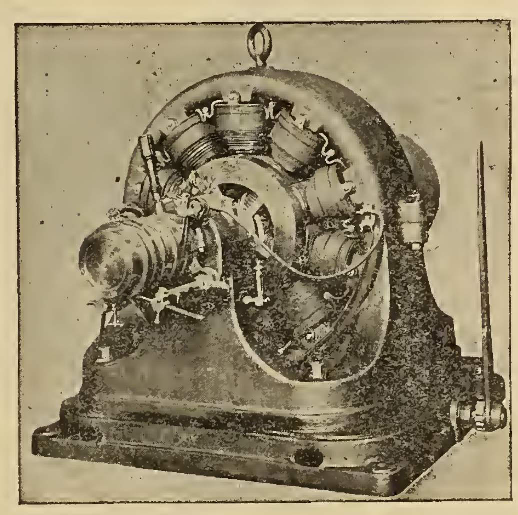

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NOTICE. The **Westinghouse** Alternator is the **only** Alternator of its type in which the Armature Coils are **removable** and may be **kept in stock.** Coils are lathe wound, thereby securing the highest insulation. **All** armatures are **iron clad.**

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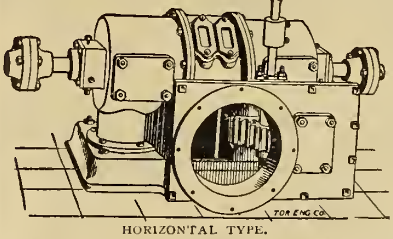
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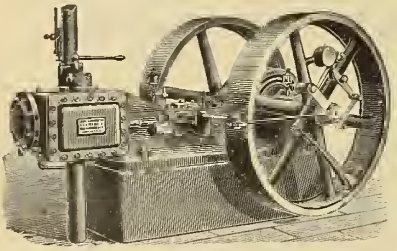

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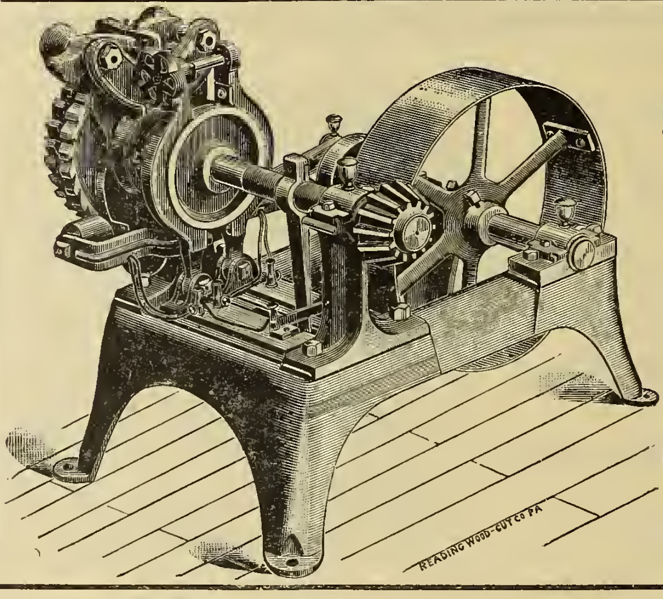

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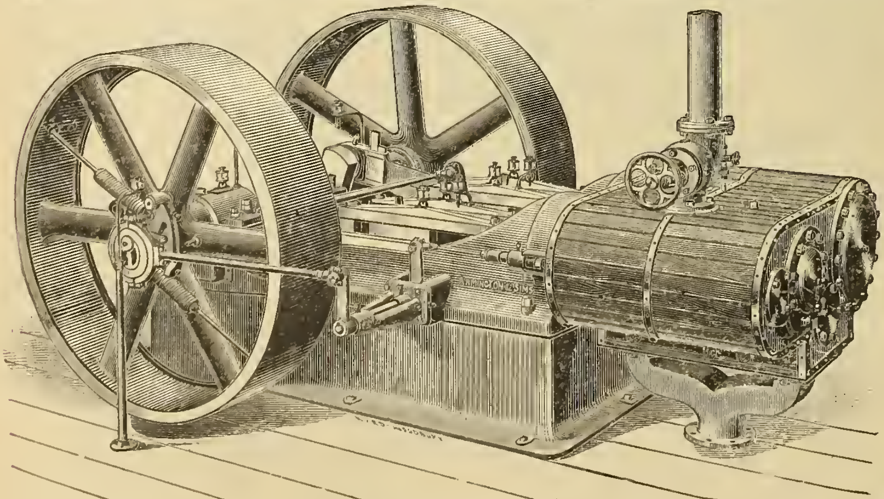
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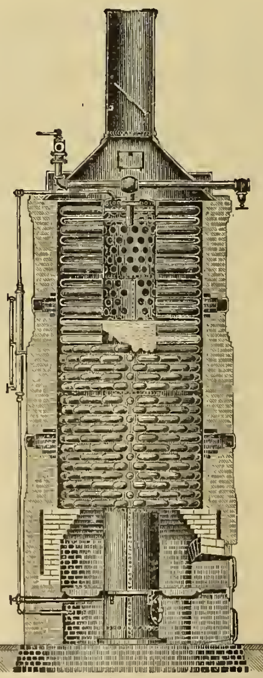

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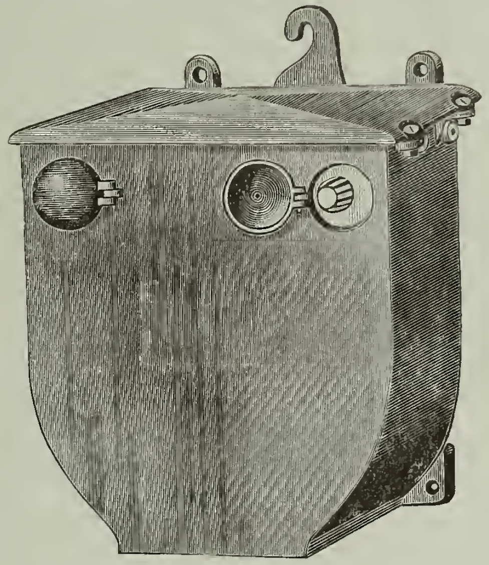

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In construction, the ring form for the coils, which has always been acknowledged as theoretically the only correct form, has been followed. In this form there is absolutely no dead wire, as is the case with all other forms on the market, and the iron is so distributed that the field on every side is equal. There is but one joint in the magnetic circuit, and the energy required for magnetization is reduced to a minimum. No laborious effort has been made to get a so-called "separable" core, as naturally the separable form cannot be as efficient, having several distinct breaks in the magnetic circuit, which cause, in addition to the inevitable loss of efficiency, excessive heating and a disagreeable humming noise, besides which the separable form is generally more difficult to take apart and rebuild than the built-up form which we use. The core of our transformer is the only one on the market having but one break in the magnetic circuit. The practical difficulty encountered in this form of construction has been to secure the proper insulation of coils. This we have overcome by an entirely new method of transformer winding, and have made a coil which absolutely cannot burn out when loaded to its rated capacity. In short, we have a converter which approaches very nearly to perfection in every particular.

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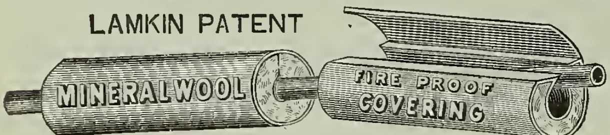

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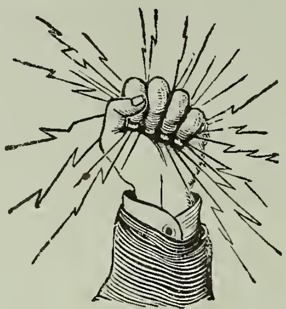

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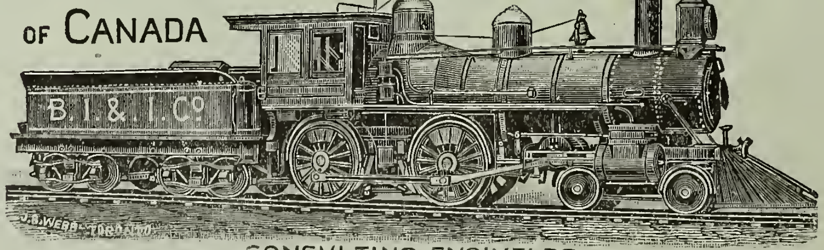

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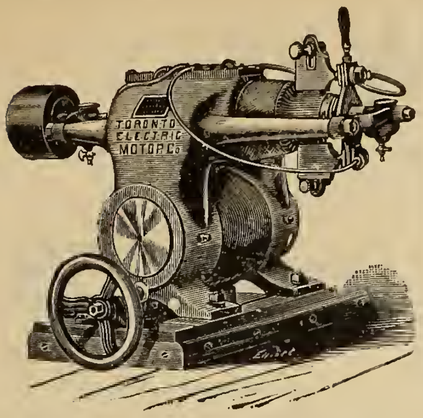

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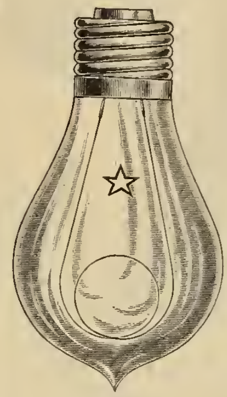

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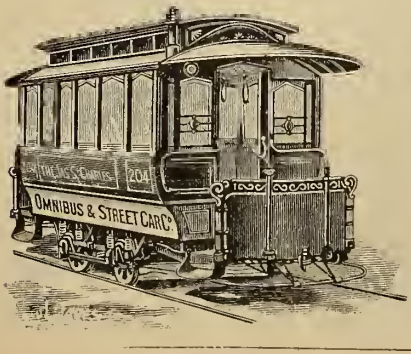

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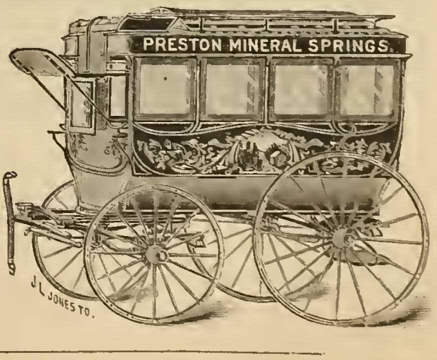
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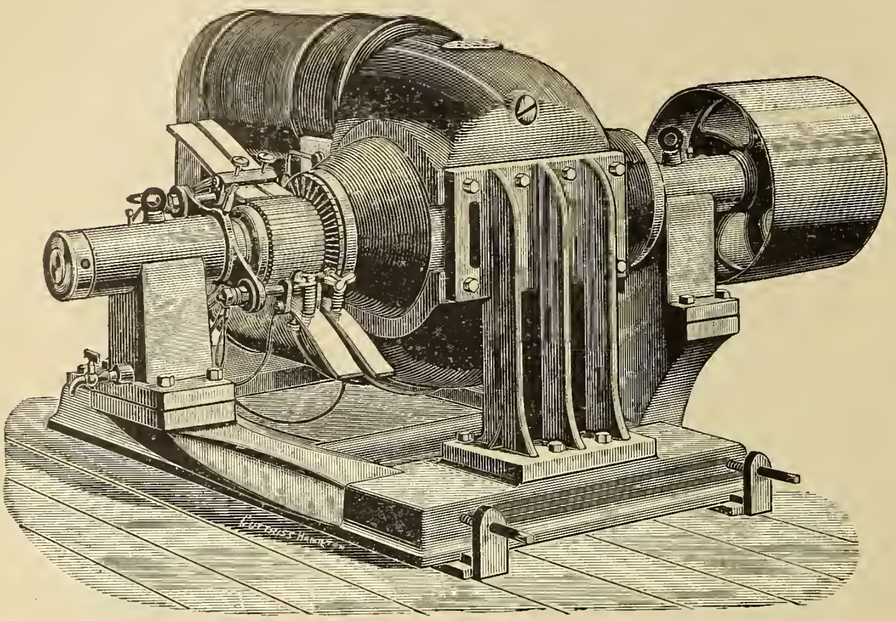

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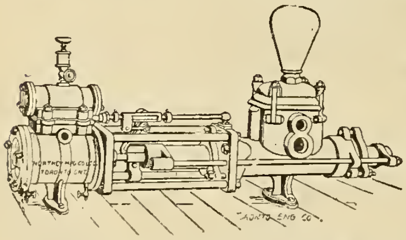

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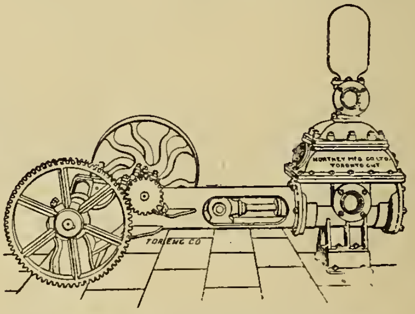

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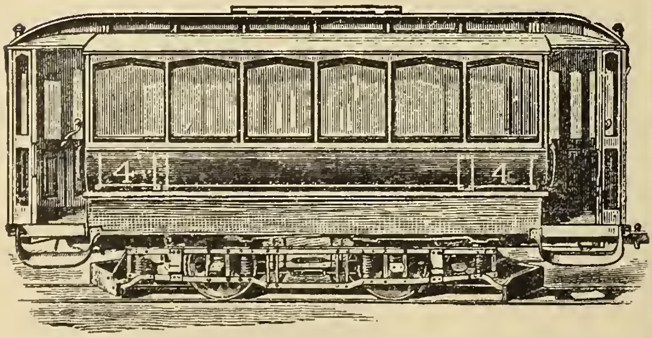

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CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. IV. JULY, 1894 NO. 7.

Thomas A. Edison

THOMAS A. EDISON.

WE present as a frontispiece to this number of the ELECTRICAL NEWS an excellent portrait of Thomas A. Edison, the famous electrical discoverer and inventor. Mr. Edison, who is of Dutch extraction, was born in Erie County, Ohio., 46 years ago. Owing to reverses which overtook his family, he was at an early age obliged to seek his own living. He began his business career as a newsboy on the Grand Trunk railway and while thus employed commenced studying and experimenting in chemistry. At seventeen years of age he is said to have become one of the most expert telegraphers on the railroad. The history of his greatest achievement, the incandescent electric lamp, and the legal battles which he has had to fight to maintain his rights as the inventor, will be fresh in the minds of our readers. The inventive character of Mr. Edison's mind can be judged by the fact that he has been granted no less than 720 patents, while in addition he has 150 applications on file.

THE BEST RESISTANCE FOR THE RECEIVING INSTRUMENT ON A LEAKY TELEGRAPH LINE. *

BY PROF. W. E. AYRTON, F. R. S., AND C. S. WHITEHEAD, M. A.

1. If there be a single earth fault at any one point of an otherwise good telegraph line, P Q (Fig. 1), it is easy to prove that the best resistance to give the receiving instrument at either end of the line is equal to the apparent resistance of the line tested from *that* end when put to the earth at the other end through a resistance equal to that of the signalling battery at that end. For example, if we desire to know what should be the value of q, the resistance of the receiving instrument at the Q end, the line must be tested from the Q end (Fig. 2) when put to the earth at the P end through a resistance, b, equal to that of the signalling battery usually employed at that end.

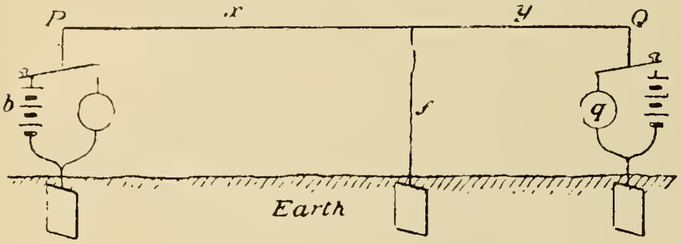

FIG. 1.

And the magnetic effect produced by an electro-magnet of given size, shape, and construction is proportional to the product of the current into the square root of the resistance of the wire with which the coil is wound. Therefore it follows that the magnetic effect of the receiving instrument at Q is proportional to $A \sqrt{q}$, and this has a maximum when q is equal to the apparent resistance of the line tested from the Q end and put to earth at the P end through a resistance b.

2. During the course of some lectures at the Guilds Central Technical College last year on faults on telegraph lines, the question arose whether the above result was universally true for a distributed leak all along the line, or only for a single earth fault; and, if this solution were not generally true, then what was the best resistance to give to the receiving instrument at the end of a telegraph line the leakage along which followed any law. The complete solution of this question shows that when the line is uniformly leaky the receiving instrument ought to have a resistance equal to the apparent resistance of the line when tested at the receiving end and put direct to earth at the sending end.

The resistance of the signalling battery does not in this case appear in the best value to give to q, but that arises from the fact that, whereas when we are dealing with a single earth fault we assume that the signalling battery had a fixed E. M. F. and a fixed resistance, here we have assumed that the potential of the sending end of the line, was kept constant. Now this is the same thing as supposing that the signalling battery of fixed E. M. F. has an extremely low internal resistance. The two results are therefore the same.

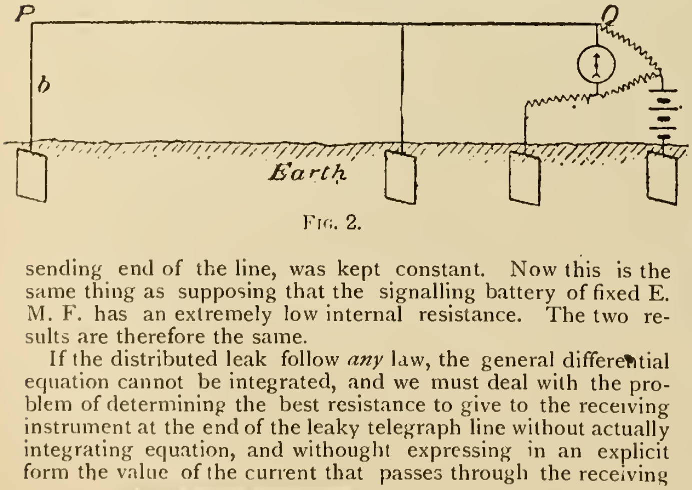

FIG. 2.

If the distributed leak follow *any* law, the general differential equation cannot be integrated, and we must deal with the problem of determining the best resistance to give to the receiving instrument at the end of the leaky telegraph line without actually integrating equation, and withought expressing in an explicit form the value of the current that passes through the receiving instrument. The Paper shows by an elaborate mathematical calculation that, whatever be the nature of a leak on a telegraph line—whether the leak be a single one, or be distributed along the line according to any law of distribution—the same rule holds true for the best resistance to give the receiving instrument, viz., the receiving instrument at either end should have a resistance equal to the apparent resistance of the line when tested from that end and put direct to earth at other end.

THE HAMILTON PUMPING ENGINES.

HAMILTON, ONT., June 14th, 1894.

Editor ELECTRICAL NEWS.

SIR,—There has been a great deal said of late about the Hamilton pumping engines. I took a trip to see them, and think the less said about them the better. They look as though they had been at war with something. If they have not broken down what have all the iron straps been put on them for? As for the test, like many another made in this city, it was of a kind which any capable man should be ashamed to have anything to do with. Can any one point me to a first-class engine made in Hamilton in twenty years, with one exception? I know there has been a great deal said in favor of the engines made and sold here, but if one of them should be loaded to its rated capacity, there would be witnessed lots of fun. We expect to see a first-class engine turned out of Hamilton in a few days. In the meantime let us have a rest from the Hamilton pumps. What with pumps, engines, parks and mountain, we are a laughing stock for the country.

Yours truly,

"OIL CAN."

MOONLIGHT SCHEDULE FOR JULY.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	
1......	P. M. 7.50	A. M. 3.40	7.50
2......	" 7.50	" 3.40	7.50
3......	" 7.50	" 3.40	7.50
4......	" 7.50	" 3.40	7.50
5......	" 7.50	" 3.40	7.50
6......	" 7.50	" 3.40	7.50
7......	" 8.50	" 3.40	6.50
8	" 9.50	" 3.40	5.50
9......	" 10.20	" 3.40	5.20
10......	" 11.00	" 3.40	4.40
11......	" 11.30	....	4.10
12......	....	" 3.40	
13......	A.M. 12.30	" 3.50	3.20
14......	" 1.00	" 3.50	2.50
15......	" 1.40	" 3.50	2.10
16......	No light.	No light.	....
17......	No light.	No light.	....
18......	No light.	No light.	....
19......	P. M. 7.40	P. M. 10.10	2.30
20	" 7.40	" 10.40	3.00
21......	" 7.40	" 11.00	3.20
22......	" 7.40	" 11.30	3.50
23......	" 7.40	" 12.00	4.20
24......	" 7.40	A. M. 12.20	4.40
25......	" 7.40	" 12.50	5.10
26......	" 7.40	" 1.10	5.30
27......	" 7.40	" 1.30	5.50
28......	" 7.30	" 2.20	6.50
29......	" 7.30	" 3.20	7.50
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CAUSES OF EXPLOSIONS.

THE causes of explosions may be summed up in one sentence, namely, lack of strength to withstand the pressure. This want of strength may be due to faulty construction, but as a rule it is due to some acquired weakness, unknown simply because unlooked for. Weakness results from unequal heating, which produces unequal expansion, from corrosion, improper setting, scale, low water and want of circulation. It may not always be possible to avoid unequal heating, as for example, in getting up steam many boilers will be hotter in some parts than in others, but scale can be prevented by "boiler compounds," and low water by a little care. In some types of boilers no provision is made for water circulation, and unequal heating is bound to occur. A thorough inspection from time to time will inform the engineer if his boiler is weakened by it, but the best plan is to use some other type. To sum up, the engineer must understand and act upon the motto, "eternal vigilance is the price of safety."—Safety-Valve.

The receipts of the Montreal Street Railway for May were the largest since the adoption of the electrical system, amounting to $85,000, an increase of $25,000 over the corresponding month of last year.

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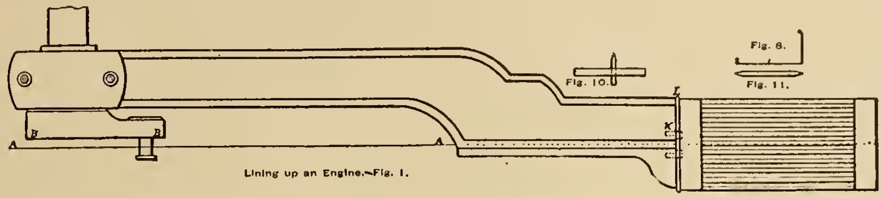
* Abstract of a Paper read before the Institute of Electrical Engineers.

LINING UP AN ENGINE.

By W. E. Crane.

Engineers are often bothered by the pounding of their engines, and as pounding can be heard by everyone in the neighborhood, it is very annoying. There are many things that cause pounding, so that in some engines the cure of it is quite a complex subject. Being out of line is the general cause. Either the shaft is not in line with the cylinder, or the crank pin is not put in straight, or something else of the kind is the matter. A high speed engine perfectly in line will be very apt to pound with a light load, unless there is considerable depression, owing to the heaviest thrust coming on the end instead of the commencement of the stroke. The thrust is caused by the momentum of the moving parts. To ascertain if an engine is in line, the back cylinder head should be taken off, the piston, piston rod, and cross-head should be taken out of the way, and a line A A, Fig. 1, should be put through the cylinder and extended beyond the crank. To hold this line in the cylinder we take a strip of board, A, Fig. 4, and bore a couple of holes to fit over two of the studs at the end of the cylinder, and in the center of the board we bore a larger hole, say 1½ or 1¼ inches in diameter, and attach the cord to a little stick B, that stretches across the hole. The strain on the cord will hold this in position, and it can be readily shifted.



Lining up an Engine.—Fig. 1.

In front of the crank set up an upright, A A, Fig. 5, with a hole in it and a stick B across it. The hole should be in line with the middle of the crank pin. The cord used for this purpose should be strong and small, and should be made of something that will stretch perfectly straight. A silk hair line, such as is used by fishermen for fly fishing, is the best. Some men use annealed wire, but wire gets hard and stiff, and kinks get in it which can never be perfectly straightened, and one of these kinks is very apt to come where you want a perfectly straight line. Wire is not recommended. Be sure that the stuffing box K, Fig. 1, is perfectly clean. Attach one end of the cord to the stick B, Fig. 4, and the other end to the other stick. The cord should then be drawn so tight as to be perfectly straight. It can be tightened by turning the stick B over and over. To center the string cut a stick a trifle over one-half the diameter of the cylinder in length, and try the cord in the end of the cylinder, cutting off the caliper stick as occasion requires, until the cord is exactly in the center of the cylinder. Then get a shorter stick and try in the stuffing box, moving the end of the cord that is beyond the crank until the cord is centered in the stuffing box. Then go to the back end of the cylinder and try that again, and so on from one to the other until the line is exactly in the center in both ends of the cylinder. There is now a line to work from to bring everything straight with the cylinder.

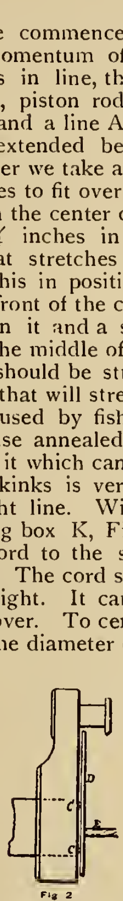


Fig. 2.

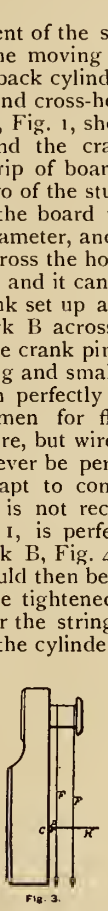


Fig. 3.

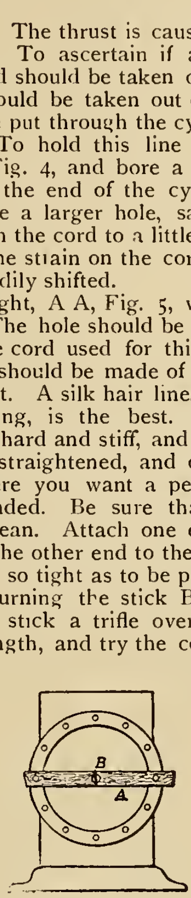


Fig. 4.

The first thing is to find out if the guides are in line. Take a stick (Fig. 10) with one side straight. Bore a small hole in it and put in a second stick, as shown in the cut so that it will be held snugly but will still be loose enough to be easily moved. Set this stick against the edge of the guides at I and J, Fig. 6, and move the small stick up to just touch the line. The end of this stick should be sharpened so as to bring a small surface to the line. If the guides are in line, the stick should just touch the line when tried at both ends. If they are not in line it will touch the line at only one end. If that is the case there is but one remedy, and that is to swing the cylinder around and put in strips of brass at L, Fig. 1, as this is the place that the guides are usually out. This is quite a job and requires some time and considerable patience. It is occasionally necessary to shim the cylinder up on the other side. The line will now have to be set over again until it is once more straight with the cylinder and guides. Fig. 7 is a cross section of the guides through the line XX, Fig. 6. A plump line suspended from point P will tell if the guides are perpendicular. If not, the bed should be swung over, or around, until they are. In case this cannot be done, either the cross-head will have to be changed in the shoes, or the shoes themselves changed so as to run straight in the guides, and at the same time bring the cross-head pin level. Knowing the style of cross-head it would be easy to tell how to do this. It is a very good test for an engineer's judgment.

The next thing to consider is the crank. Cut a small stick that will just fit into the crank, and mark a line across the center. Bring the crank pin up under the line till it touches, and note whether the line crosses the mark on the stick, or how much of it is out; and then turn the crank around and bring the pin up under the line on the other side. Note how much it is out on that side, and if out, whether it is on the same side of the mark as before, or on the opposite. If on the side, it shows that the center of the pin is not in line with the cylinder, and the shaft must be shoved endwise until the line crosses it at the middle. If the construction of the engine will not allow this with the means at hand, take off from the side of the crank-pin boxes the amount that the line shows that it is out. Then fit pieces of brass on the other side of the crank-pin boxes to make up what has been taken off. If the boxes can be recessed for these pieces, all the better; but if not, they can be fastened in with pins. If the line is on one side of the mark when the crank is on the center, and on the other side when on the other center, it shows that the shaft is not square with the cylinder, in which case the outer end of the shaft should be swung around to bring it straight with the line. If it should happen that the shaft could not be moved at that time, the distance that it must be moved can be calculated, and then it can be done any time afterwards.

Suppose that Fig. 8 is a shaft and crank. It is plain that as the distance from the angle to 1, in either direction, is the same, moving one of these points a certain distance will move the other one the same distance; but if we double the distance to one of them, carrying us to 2, then we should move 2 twice the distance that we should 1; so that to find the distance we should move the end of the shaft we must divide the length of the shaft up to the outer pillar block by the length of the crank (not the length of the stroke), and multiply the result by the distance that the line is out from the mark on the pin. For instance, if the mark on the pin is out 1-16, the shaft 2½ feet long, and the crank one foot long, we multiply the 1-16 by 2½, which makes 5-32 that the outside pillar must be moved. To find if the shaft is level, place the crank upright and suspend the plumb line down over the end of the pin, and then turn the crank down and note how much it is out. A similar calculation will give the amount the end of the shaft must be raised or lowered. To determine if the crank pin is straight with the shaft would be an easy matter if the face of the crank was flat; but as a general thing, when the shaft is finished it is left uneven, as can be seen by putting on a steel straight edge. Even if the face is flat it is possible that it is not square with the shaft. To determine, then, if the pin and shaft are parallel take two thin blocks C C, Fig. 2, and a straight edge D, and hold them in position by the stick E placed against any handy support. The blocks C C should be placed against the end of the shaft the same distance from the center. The straight-edge D will then be at right angles to the shaft, and a square placed against the face of it and against the pin will show if the pin is straight one way. To determine if it is straight the other way, place the blocks C C and the straight-edge D in a horizontal position, suspend two plumb lines, F F, over the pin, as shown in Fig. 3, and run the square H along the straight-edge to the lines, when it should touch both lines. Should the pin become loose in the hole, and it be necessary to bore out the hole before putting in another pin, the boring can be set in the same way.

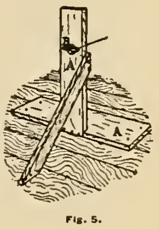


Fig. 5.

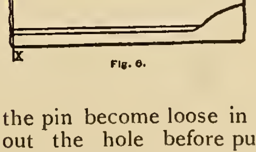


Fig. 6.

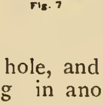


Fig. 7

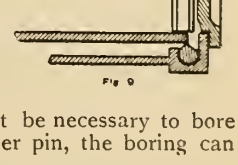


Fig. 9

It should be remembered that a crank-pin wears only on one side, and also that, if it has been out of line, one end may be worn more than the other. This can be ascertained by calipering, and if the pin is not straight the difference must be allowed for, according to the circumstances of the case in hand. When the brasses have been babitted, there will be a small ring on each end of the pin that will not be worn. Pounding is sometimes caused by the piston running over the ports, as shown in Fig. 9. The piston may then be thrown to one side, or raised up from the bottom, even when the steam enters the top. When such is the case, nothing can be done except to make the piston fit the cylinder as well as possible. Fig. 11 is a caliper stick for setting the line, and can be whittled out of any handy piece of pine.

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Correspondence is invited upon all topics coming legitimately within the scope of this journal

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MONTREAL BRANCH NO. 1.—Meets 1st and 3rd Thursday each month, in Engineers' Hall, Craig street. President, Jos. Robertson; first vice-president, H. Nuttall; second vice-president, Jos. Badger; secretary, J. J. York, Board of Trade Building; treasurer, Thos. Ryan.

ST. LAURENT BRANCH NO. 2.—Meets 1st and 3rd Tuesday each month, in Mechanics' Institute, 204 St. James street. Matthias Guimond, President; Alfred Latour, Secretary, 306 Delisle street, St. Cunegonde.

BRANDON, MAN., BRANCH NO. 1.—Meets 1st and 3rd Friday each month, in City Hall. A. R. Crawford, President; Arthur Fleming, Secretary

GUELPH BRANCH NO. 6.—Meets 1st and 3rd Wednesday each month at 7:30. p.m. C. Jorden, President; H. T. Flewelling, Secretary, Box No 8.

OTTAWA BRANCH, NO. 7. — Meets 2nd and 4th Tuesday, each month, corner Bank and Sparks streets; Frank Robert, President; F. Merrill, Secretary, 352 Wellington Street.

DRESDEN BRANCH NO. 8.—Meets every 2nd week in each month; Thos. Merrill, Secretary.

BERLIN BRANCH NO. 9.—Meets 2nd and 4th Saturday each month at 8 p. m. W. J. Rhodes, President; G. Steinmetz, Secretary, Berlin Ont.

KINGSTON BRANCH NO. 10.—Meets 1st and 3rd Tuesday in each month in Fraser Hall, King Street, at 8 p.m. J. Devlin, President; A. Strong, Secretary.

WINNIPEG BRANCH NO. 11.—President, Chas. E. Robertson; Recording Secretary, L. Brandon; Financial Secretary, Arthur Harper.

KINCARDINE BRANCH NO. 12.—Meets every Tuesday at 8 o'clock, in the Engineer's Hall, Waterworks. President, Jos. Walker; Secretary, A. Scott.

WIARTON BRANCH NO. 13.—President, Wm. Craddock; Rec. Secretary, Ed. Dunham.

PETERBOROUGH BRANCH NO. 14.—Meets 2nd and 4th Wednesday in each month. S. Potter, President; C. Robison, Vice-President; W. Sharp, engineer steam laundry, Charlotte Street, Secretary.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

BOARD OF EXAMINERS.

President, A. E. EDKINS, -	139 Borden st., Toronto.
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PETERBORO'—S. Potter, care General Electric Co.
BRANTFORD—A. Ames, care Patterson & Sons.
KINGSTON—J. Devlin (Chief Engineer Penetentiary), J. Campbell.
LONDON—F. Mitchell.

Information regarding examinations will be furnished on application to any member of the Board.

THE thirteenth annual meeting of Railway Superintendents of Telegraph of the United States and Canada assembled in Detroit on June 13th. A number of interesting papers were included in the programme. It was decided to hold the next convention in Montreal on June 14th, 1895.

PRINTERS' Ink compares an advertisement to an electric current. The newspaper is the switchboard. The advertisement is the operator. When the advertiser would electrify the public he manipulates the switchboard, and the powerful current which he so thoroughly controls enlivens the community and often shocks or even kills a competitor.

SOME gentlemen at Rat Portage recently solicited from managers of electric lighting companies throughout Canada, details of cost, etc., of operation of central stations. The request was accompanied by the promise that to those who responded favorably to the request for information, a copy of the statistics thus gathered and to be compiled would be furnished. The parties interested are enquiring why this promise has not been fulfilled.

A REPRESENTATIVE of THE ELECTRICAL NEWS who recently visited Iroquois, Ont., was surprised to find the town enveloped in darkness after nightfall. He was still more surprised to learn that there is lying idle in the town a complete electric lighting equipment. The town's financial condition not being as favorable as could be desired, the Council have been cutting down expenses, and have refused to spend the money sufficient to light the streets. The lighting company have offered to supply ten 2000 c. p. arc lamps at the exceedingly low price of $40 per lamp per year. It is very doubtful economy to rob the town of its attractiveness and the citizens of their comfort for the purpose of effecting so small a saving. This is the view of a majority of the taxpayers. This case serves to illustrate what a pleasant and profitable business it sometimes is to supply electric light to municipalities.

THE Dominion Government will be asked to make a grant of money towards defraying the cost of a Dominion Exhibition in Toronto in 1895. The so-called Dominion Exhibitions which have been held in the past have not even in a moderate degree been representative of Canadian progress. An Exhibition which should be truly Dominion in character would be likely to result in adding to the population and business of the country. Something of the kind is needed at the present stage in our history, and we therefore hope the Federal and Provincial Governments will liberally assist the Toronto Board of Trade, the Industrial Exhibition Association and others interested, in bringing the project to a successful issue.

THE effort of a company to secure the passage of a Bill through the Dominion Parliament giving them the right to construct an elevated railway through certain of the principal streets of Montreal, was nullified by the determined opposition of the citizens. The Bill, as it passed the House, provides that before construction shall begin, compensation shall be made to the owners of property which would be damaged in value by the carrying out of the enterprise. This provision of the Bill will it is believed be sufficient to stop the further progress of the scheme. In a city of compact area like Montreal, there does not appear to exist the slightest necessity for an elevated street railroad. The electric street cars answer all the requirements, and in placing property owners beyond the reach of possible blackmail, Parliament has done an act of simple justice. There has been too much juggling with public franchises of late in the city of Montreal.

AMONGST the necessaries of life the telephone has taken its place, and as such it is interesting to compare its cost to the user in different countries. In Austria-Hungary, where the state telephones cover the whole country outside of Vienna, there is an installation charge of $25 and an annual rental of $25 more. Switzerland has gradually reduced the charge until now it is about $16 per annum. In France, telephones are managed by the state, and the charges are $40 for towns with over 25,000 inhabitants, and $30 for smaller towns. In Italy, for ordinary sized towns, the cost is from $25 to $30. In Sweden, where the telephone is very generally used, there is an extensive system of state telephones charging $22, whilst in the smaller towns the rates of private local companies are as low as $8. In Norway the cost varies according to the size of the town, from $11 to $12, and in Spain from $15 to $55. Holland has a Bell Telephone Co. which almost monopolizes the business, and the cost ranges from $50 in the large towns to $25 in those of about 30,000 inhabitants, and to $20 in still smaller towns. In Belgium the charges are from $25 to $30. In Denmark the Copenhagen Telephone Co., which connects by telephone cable with the Swedish system, charges $41 annual subscription. In the provincial towns the cost varies from $7.50 to $21. Finally, in England a telephone in London costs $100 annually, and in other towns from $40 to $50. In comparison with these prices we in Canada have nothing to complain of with $45 per annum for an office telephone and $25 for a house telephone in a city the size of Toronto.

THE project of a wire rope tramway across the Niagara gorge, which sought incorporation this session at Ottawa, draws attention to the increase of late years in the use of this method of transportation, which after suffering the usual vicissitudes of all new engineering enterprises, has survived the dangers of ignorant childhood and stormy youth, and now in about the fortieth year of its existence, seems to have found its place in life, and bids fair to enter upon a vigorous manhood. The sphere of usefulness which seems particularly its own is that of transporting such materials as ores, clay and coal, etc., over rough and hilly country where a surface or trestle road would be very costly, or where grades have to be surmounted which would be impossible with ordinary traction by friction of driving wheels. It also finds a useful place in the carriage of such materials as already mentioned across rivers. Of the two methods, the "single rope" system in which single endless rope is kept in motion over guide sheaves and serves both to support and convey the buckets, and the "fixed rope" system in which a light endless traction rope hauls trolleys running on stationary cables as rails, the latter method has generally survived as the fittest. Much thought, skill and labor has gone to produce its successful simplicity. The speed is from 3 to 4 miles per hour. Clear spans of 1200 to 1700 feet are not uncommon, and one line has a clear span of 2250 feet at an incline of 45 degrees, carrying down loads of 1200 lbs. at each trip. This last is marked as a gravity road, the descending loaded bucket hauling up an empty. These lines ordinarily do not exceed a mile in length, though there is one a little over three miles long which has a daily capacity of 750 tons. There are, however, no long spans on this line and only 240 feet difference of level between loading and discharge terminals, an average grade of only 1½ per cent. The entire operating expenses of this line per annum, including depreciation, taxes, etc., are stated at 6 cents per ton mile for about 200,000 tons carried. For this distance and easy grade it is not clear that electric telpherage might not have been better. For wire rope tramways, where the grades are heavy or the line short, the traction cable has no real rival; but for long distance and nearly level lines with short spans, electric should beat cable haulage on overhead railways as it has on surface roads, and as wire rope tramways come more into general use, some application of the late Fleeming Jenkins electric telpherage system may well serve to extend their economical range.

THE remarks in last month's ELECTRICAL NEWS on municipal ownership of lighting plants, have excited adverse comment from the daily press advocating a city plant for Toronto. The gist of their criticisms is a sneer at what they are pleased to call our "time worn argument" that a large civic corporation in this country cannot be trusted to carry on business as economically and efficiently as a private company. That this truth is old enhances the discredit it casts upon the system of municipal government in the large towns of this country and continent. If it is old there is the greater need that it should be refuted by facts, and before asking for new opportunities to do this, it is incumbent on the civic representatives to use those already afforded them. Let them put their house in order and make a creditable record with what has been given them before they ask for more. Is the history of the Toronto Waterworks one to inspire confidence in our civic government? And how are we to believe that this history will not repeat itself, when at the present moment with our comparatively excellent Council, we see a sound and practical scheme for immediate relief by a tunnel to the island, blocked by a faction of aldermen who want to wait ten years longer and pay twenty times the money to get less pure water from Lake Simcoe in the end. Granted that the actual operation of civic waterworks, electric light and similar plants is in charge of the permanent officials, one of the most important of whom is the City Engineer, and that the present incumbent of that office is thoroughly capable and trustworthy—so also have been some of his predecessors, and there's the rub. How many city engineers has Toronto had in the last ten years? We do not suppose that the most enthusiastic civic advocates will claim better business management by the city than by a private company whose existence depends on good management; and the plain truth of the matter is that with equally good management the city of Toronto would at best have just this one advantage in the competition, that it need only pay 4% dividends (in the form of interest on debentures) against 8% on the same capital that would be required from a private corporation. And, with such a narrow margin for competition, what man in his senses would invest in a business corporation which, like the city, changes its directors once a year and its manager every two or three years? In private life we don't entrust our money to a concern whose directors have shown themselves capable of dallying with a so-called engineering project to shunt Niagara Falls by emptying the Georgian Bay into Toronto Harbor.

AN English Royal Commission to inquire into the subject of "Electrical Communication with Lighthouses and Light Vessels," has recently issued its second report, which gives as an appendix a sub-report by Sir Edward Birbeck, who visited Canada and the United States to see what had been done on the subject in America. He speaks in very high terms of the complete and efficient system of telegraphic communication with Canadian lighthouses, but adds that the question of cable communication with Canadian light vessels has not been taken in hand owing to the necessity of moving many of them from their stations during the winter on account of the ice. Cable connection to a lightship is a difficult and costly matter at best, as the sea end of the cable must be securely anchored and provided with a watertight service, kept clear of the sea bottom, to allow the lightship to swing at its moorings. Ice and the necessity of moving the vessel would add greatly increased if not insuperable difficulties to direct cable connection. As a means of filling this gap in the otherwise very perfect Canadian system of lighthouse communication, recent experiments on indirect or inductive electric signalling are of special interest to us in Canada. It is now some years since Edison brought out his method of electrical communication by electrostatic induction without metallic connection, and applied it to transmitting signals, between a moving train and the ordinary telegraph wires running beside the track. It is a familiar fact that when a condenser of sufficient capacity is interposed in a line conveying a pulsating or alternating current, such as a telephonic current, the current is perfectly transmitted by electrostatic induction in the condenser, in spite of the open circuit. Edison simply increased the distance between the plates of the condenser. In the case of the moving train the tin roofing of the car was one plate, and the wire beside the track the other plate. A conducting sheet hung between the masts of a vessel would enable it to signal to another vessel similarly equipped, or to the land if a like conducting sheet were erected on the shore. In the recent experiments referred to, electromagnetic induction is employed, and electrical energy transmitted between two separated wires on the same principle as in a Ruhmkorff coil or an ordinary alternating current converter; the only difference being that the primary and secondary wires are separated by hundreds of feet instead of by fractions of an inch. Mr. Preece has been experimenting between two parallel lines of wire, and Mr. Stevenson between two coils. A trial system of the coil variety is being put up to establish communication between the North Unst lighthouse and the shore, half a mile distant. For lightships the method would be to lay out from shore a cable, and coil it on the sea bottom in a circle of large enough diameter that the lightship swinging at its moorings may always be within the circle, the second coil being on board the vessel itself.

MUNICIPAL LIGHTING.

ELSEWHERE in this issue we print the report of Secretary McGowan of the Toronto Fire and Light Department on the probable cost of operating a municipal lighting plant. It appears that City Engineer Keating was requested to make the estimate in the first place, and did so. But having had no experience in electric lighting he had to depend for his information, as is usual in such cases, on parties whose interest it was to have a city plant established regardless of what it might afterwards cost to maintain. The matter properly belonged to the Fire and Light Department, so as there was some doubt as to the correctness of the Engineer's figures, Mr. McGowan was instructed to report on the estimate. It is fortunate for both the taxpayers and electric light companies that Mr. McGowan, who has had charge of the city lighting for ten years past, is both an expert in those matters, and also an honest and fearless man who is prepared to do his whole duty regardless of aldermanic interference or adverse criticism of the press. We leave it to any of our practical readers to say whether the estimate is not a fair one, and thoroughly within the mark for a municipal plant. The wages are based upon what the city is now paying for similar kinds of labor, and the number of employees on what would be necessary for a plant run by a private company, to say nothing of the extra cost that would be entailed by pitchforking into office the numberless parasites that it seems to be necessary shall always feed on the body politic. The cost of 2000 candle power lights as supplied by the Toronto Electric Light Company is $108 per year for 1000 lights; Mr. McGowan's estimate is $103.85 each for 1300 lights. There is not an electric light company in existence who would not willingly take for their pay the actual cost price to their municipality, being content to take for their profit the difference between skillful, independent and economical management and the corrupt and extravagant methods of the average ward politician. The item in Mr. McGowan's estimate that has provoked the most opposition is the amount for taxes. The irate socialist says: "What is the use of placing this in—you can't tax civic property." Certainly not, but you can and will lose the amount which the electric companies are now taxed if you destroy their property; and in all conscience, in Toronto that tax is high enough. There is another item that the Secretary has omitted, which would also be a proper charge against a municipal plant, and that is rebates charged for lights out. It is unavoidable, even with the best known appliances, that lights should sometimes fail. Lightning, sleet storms, accidents to wires through crosses, or from falling trees, and from numberless other causes. These, whereas in the case of Toronto, the policemen report the lights that are out, amount to quite an item during the course of a year. Not only would a municipal plant lose the benefit of this, but the service would not be as effective, there being no incentive to attain perfection to save this item of expense. It is evident to those who peruse the City Engineer's estimate that, from the entire omission of important items of expense, such as globes, &c., that it is not a reliable one, and should therefore give place to the more thorough one of the Fire Department Secretary. We commend with much pleasure the study of the report to our electrical friends, and to politicians afflicted with the prevailing craze for municipal ownership.

CANADIAN ELECTRICAL ASSOCIATION.

A WELL attended meeting of the Executive Committee of the above Association was held in Toronto on June 25th. Several new members were elected. Some eight or nine gentlemen prominent in electrical circles have consented to prepare papers of interest to students and workers in the various departments of the electrical field, for the annual meeting to be held in Montreal in September. The exact date of the convention will be fixed shortly. It will probably be between the 20th and 30th of September. The meetings will be held in the Mechanics' Institute, will occupy three days, and promise to be very full of interest. A committee was appointed, comprising chiefly members of the Executive resident in Montreal, to further the arrangements. The Executive expect to be able to secure from the railways such favorable transportation rates as will enable a large proportion of the members of the Association from Ontario to attend the convention. An invitation has been extended by the authorities of McGill University for the Association to visit and inspect that celebrated institution. A drive to the summit of Mount Royal, a run down the Lachine Rapids, a visit to the Montreal Street Railway Company's power station, a trip over the Montreal Island Railway, and other forms of pleasant and profitable entertainment are being arranged for. Ontario members of the Association cannot do better than postpone their holidays until the latter part of September, and take in this convention in the commercial metropolis of the Dominion, the people of which are certain to afford them a good time.

PRESCOTT ELECTRIC STATION.

The steam engine used in this power house is one of Polson's 65 h. p. When first erected it was high pressure engine, but the directors decided some time ago to attach one of Northey & Co.'s condensers, so now it is run as a low pressure engine. The addition of the condenser has increased the power from 15 to 20%, while it has reduced the consumption of coal about 7½%, consequently the change has been a most satisfactory and beneficial one.

In the power house they have two Reliance dynamos—an arc and incandescent. These dynamos are Easton's patent, and were manufactured by the Reliance Co., of Waterford, Ont. The arc dynamo has been running six years, and in all that time has not cost a cent for repairs. The incandescent dynamo has been running only five months; if it fulfils what it promises it will give as great satisfaction as the arc dynamo has done.

The Company use also the Diamond transformer, transforming the current from 1000 to 100 volts. The result is they can now supply 100 c. p. reduced to 1000 c. p., which under old circumstances could not be effected without making a series of 10 lamps.

Mr. A. H. Smith, of London, Ont., has been granted a Canadian patent for an improved trolley arm; and the Bell Telephone Co. the extension of a patent for connection devices for electric circuits.

REPORT ON COST OF CONSTRUCTION AND MAINTENANCE OF A MUNICIPAL ELECTRIC LIGHTING PLANT FOR TORONTO.

Fire Department Secretary's Office,
Toronto, June 23rd, 1894.

To the Chairman and Members of the Committee on Fire and Light:

Gentlemen,—In compliance with a resolution passed at the last meeting of your Committee asking for a report on the estimate of the cost of construction and maintenance of an electric lighting plant for the City as submitted by the City Engineer, I beg to say that the time at my disposal did not permit of my getting as much information in relation to the cost of installation of a plant as I desired, still from the particulars I have received I am of the opinion that an electric lighting plant of the capacity at present required for our city could be installed for the estimate submitted, viz.: $310,000; but supposing the cost exceeded the estimate by $25,000 it would not be a very significant matter as it would be one of first cost only.

With regard to the cost of maintenance of plant as submitted by the City Engineer, I would say that from my experience and knowledge of the cost of operating a plant of the proposed dimensions, I am of the opinion that it is considerably underestimated, and beg to submit the following as a fair estimate of the annual cost of operating and maintaining:

Annual Cost of Operating and Maintaining Station.

1 superintendent	$ 2,500 00
1 chief engineer	2,000 00
2 assistant engineers	2,000 00
1 electrician	1,500 00
2 oilers	1,200 00
2 dynamo tenders	1,500 00
1 dynamo cleaner	600 00
4 firemen	2,800 00
1 helper	500 00
20 trimmers, including two spare at $550 per annum	11,000 00
7 inspectors, at $600 per annum	4,200 00
1 foreman of trimmers and inspectors	800 00
1 horse, wagon and driver for lamp department, and keep of horse	975 00
5 linemen	3,000 00
1 team horses, wagon, harness and keep of horse for pole and line work	1,000 00
1 clerk	800 00
1 storekeeper	800 00
3 machinists	2,100 00
Materials for repairs to lamps, dynamos, engines and boilers	3,000 00
Maintenance and renewal of tools and implements for repair shop and linemen	500 00
Globes for lamps	1,950 00
Coal	39,420 00
Carbons	14,235 00
Oil. waste, etc.	2,000 00
Interest and depreciation	31,020 00
Insurance on say $140,000	2,100 00
Taxes on assessment of say $100,000 at 15 mills on the dollar on which a private corporation would have to pay	1,500 00
	$135,000 00

On the above basis the cost for 1300 lamps would be $103.85 each per annum.

If the cost of interest and depreciation, insurance, taxes, water, etc., is added, the cost per lamp would be about $170 per annum.

Respectfully submitted.

R. J. McGOWAN,
Secretary Fire Department.

THE MARITIME PROVINCES.

(Correspondence of the Electrical News.)

The prospectus of the East River Electric Co., Ltd., of Pictou county, has just been issued. The capital stock of the company is $30,000. The prospectus sets forth that the idea has been conceived of supplying the residents of New Glasgow, Stellartan, Westville and Ferona with electric light produced by water power. With this object in view, the west branch of the East river has been examined by reliable engineers, who report that at the driest season of the year 200 h. p. may be developed by means of a dam 30 feet high, located about 500 yards below the village of Hopewell; and further, that should more power be required in future, another dam may be built further down stream, from which the same flow of water may be used again, thus assuming a total of at least 300 h. p. available, to say nothing of existing dams at Hopewell and Eureka, which may be acquired if the profits of the undertaking are found to warrant it. A prominent electrician has been consulted, and his report is that 200 h. p. will successfully operate 2500 incandescent lamps at the distance of New Glasgow from Hopewell. With this assurance careful estimates of the cost of constructing and operating the required plant have been prepared, and the result is so encouraging that it is proposed to organize the East River Electric Co., Ltd., for the purpose of developing the scheme. It is estimated that the cost of constructing and operating the works will amount to $25,000. The estimated gross revenue from 2000 lights at $1\frac{1}{2}$ cents per night is $9000. The running expenses are placed at $3,500, which would leave a net revenue of $5,500, equivalent, the prospectus says, to 10 per cent. on $30,000 and a surplus of $2500 to be used in extending the business.

Business men, both in St. Stephen and Calais are seriously inconvenienced in their relations with each other because they have no efficient telephone service. The system which is in use is only an an apology for a service, and a very poor apology at that. It is generally admitted that a first class service would become popular in both these towns, and if one were to judge from what the business men say, the telephone would be about as good an investment as the capitalist could find for his money. The New Brunswick Telephone Co., realizing the great want of the people in this line, and the field open to them, have made a proposition to the people of St. Stephen and Calais, in which the company name the rates and conditions under which they will build the line. The offer has been favorably considered by a committee representing the citizens of both towns. The Board of Trade at its last meeting considered the proposition of the company. At present there are not more than half a dozen telephone subscribers in either of the towns mentioned. It is the intention of the citizens, however, to possess themselves of a line that shall be first class in every particular. They think that with such communication business will be greatly facilitated.

Calais will very soon have an electric railway. A large crowd of men have been at work upon it for several weeks and have pushed everything along rapidly. In a few days the work of laying the rails will have been finished. The poles are now being set for the wires. There was a strike among the laborers last week, but the vacancies were soon filled and the work went on the same as usual. The cars will be right up to date in the manner of construction.

A petition is being circulated and extensively signed by ratepayers of Summerside, P. E. I., asking the council to have an electric light plant put in operation in that town. Summerside is without any doubt greatly in need of electric light. With one exception it is the largest town on the island, and the manner in which its streets are now lighted is certainly away behind the age. The majority of the citizens seem to be fully alive to the importance of the scheme, and it is believed the council will accede to their wishes and order that an electric plant be placed in operation.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of the various Associations are requested to forward to us matter for publication in this Department not later than the 20th of each month.

ORGANIZATION OF AN ASSOCIATION AT PETERBOROUGH, ONT.

149 Borden St., Toronto, June 18th, 1894.

Editor Electrical News.

Sir,—The members of the C. A. S. E. will be pleased to learn that another addition has been made to the order. The new Association will be known as Peterborough No. 14 C. A. S. E. The organization took place on June 13th in the Sons of England Hall. There are two halls, a large main hall and a small one—the latter has been engaged for the meetings of the new Association.

About fifteen engineers were on hand, when the President Bro. S. Potter, chief engineer Canadian General Electric Co., called the meeting to order, and asked the writer to take the chair and proceed with the organization.

After the officers were elected they were duly installed in their respective positions, and then the members were called in for initiation. President Potter then called on the writer to address the members on the aims aud objects of the C. A. S. E., which he did to the best of his ability, telling of the good which had been done by the Association, advising them to purchase a black board and question box, and to encourage the discussion of all matters in which engineers were interested. The attitude of the C.A.S.E. towards our employers was also touched on, and met with the heatty approbation of all present, as it must always do with all fair minded men. President Potter then took the floor and addressed the members in a neat and pleasant speech, during which he asked each individual member to do his utmost to make No. 14 one of the most useful Associations in Canada. He trusted that every member would make it a point to bring up some subject for discussion, and that they would never hesitate to express their opinions, as all were there to learn, and he knew of no better way for engineers to become educated than for them to meet together for mutual improvement and discussion of subjects relating to the duties of an engineer in his every day work. Bro. Potter expressed the opinion that No. 14 would never probably exceed 20 or 25 in membership, but he believed it would prove to be a staunch and useful Association, and he hoped a credit to the C. A. S. E.

Vice-Pres. Robison and Bro. Thos. Duncan followed and expressed their determination to make the Association a success. Bro. Duncan was at one time a marine engineer, a good arithmetician, and willing to give his knowledge to the Association.

Several other members expressed their determination to work hard to make the new Association a success.

The officers of No 14 are: President, S. Potter; vice-president, C. Robison; treasurer, W. Hunt; conductor, W. Taylor; doorkeeper, John Morency; trustees, Wm. Wilson, Thos. Duncan, J. F. Smart; Secretary, W. Sharp, (engineer steam laundry), Charlotte street. The Association will meet in the Sons of England Hall, on the 2nd and 4th Wednesday of each month. The members of No. 14 will be pleased to hear from all other branches, and papers on any subjects will be thankfully received.

This Association has made a good start, and judging from the sincerity and intelligence of the members it will be one of the most useful and progressive branches in the Province.

All members of the C. A. S. E. will wish Peterborough No. 14 long life and success in helping to educate the engineers of Canada, to a correct understanding of steam and its application to power. Yours very truly,

Albert E Edkins,
Prov. Dept., Ontario.

HAMILTON, NO. 2.

On Friday evening, June 15th, Hamilton No. 2, elected their officers for the ensuing term as follows: Joseph Langdon, president; Peter Bailey, vice-president; Wm. Norris, corresponding secretary; A. Nash, financial secretary; Wm. Nash, treasurer; Thos. Carter, conductor; Wm. Stevens, doorkeeper; Peter Stott, Robert Mackie, Andrew Robb, trustees.

During the evening an important discussion took place on the power of heat when applied to water. The subject was introduced by Bro. Wickens, of Toronto No. 1, who handled it in a very able manner.

Mr. J. J. York, Executive Secretary, has obtained a first class certificate under the Ontario Engineers' Act.

During a recent visit to Montreal, Mr. A. E. Edkins passed the required examination and received a Boiler Inspector's certificate under 57 Vic., Chap. 30, an Act of the Quebec Legislature respecting steam boilers and motive power in industrial establishments.

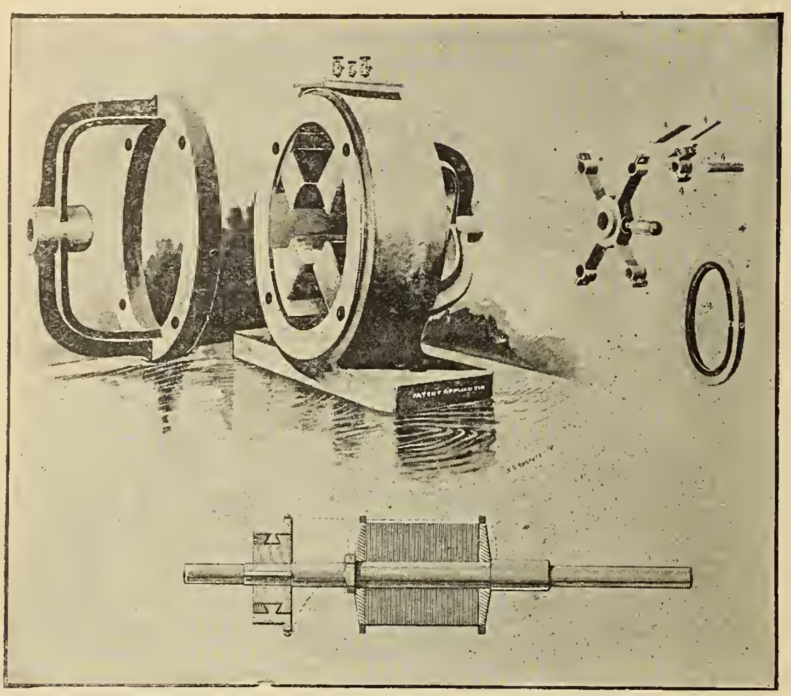
OUTFIT OF APPARATUS FOR STUDENTS OF ELECTRICITY.

The staff of instructors of the "Institute for Home Study of Electricity," conducted by The Scientific Machinist Co., of Cleveland, O., have designed an outfit of apparatus for their students, patents on most of which are pending. Descriptions and illustrations of these are here presented.

DESCRIPTION OF DYNAMO AND MOTOR.

This machine is of the iron-clad type, with poles projecting radially towards the centre.

It is fitted with self-oiling bearings of ample size, adjustable brush holder, two sets of copper brushes, and is in every respect a practical machine. In addition to the machine, as above, there are sent four insulated rings which may be secured and connected to the commutator for alternating current working. By the use of only one size of wire on field and armature, the machine is variably connected, full details of which occur in the course, as follows:



LINCOLN-AMSTUTZ EXPERIMENTAL ¼ H. P. DYNAMO AND MOTOR, FOR STUDENTS, SCHOOLS AND COLLEGES.

1. As a four-pole shunt wound dynamo delivering direct current at constant potential—two brushes only.
2. As a four-pole compound wound dynamo arranged so that the voltage rises as the load is increased—two brushes only.
3. As a series four-pole dynamo—two brushes only.
4. By changing the connections of the armature bobbins to the commutator, we may cause the machine to furnish twice the current at $\frac{1}{2}$ the voltage. Connected in this way the machine will operate as a four-pole shunt wound dynamo giving direct current at constant voltage—four brushes.
5. Also as series dynamo giving twice the current at half the voltage—four brushes.
6. As a four-pole shunt wound motor running at constant speed corresponding to case 1.
7. As a four-pole compound wound motor where the speed will drop when the load comes on, corresponding to case 2.
8. As a four-pole compound wound motor where the speed rises when the load comes on, corresponding to a variation of case 2.
9. As a four-pole series motor, corresponding to case 3.
10. By changing the connection and using four brushes we get a four-pole motor running at twice the speed it did before changing and running at double speed and power corresponding to case 4.
11. As a four-pole series motor operating at twice the speed it did before the change corresponding to case 5 was made.
12. Before rewinding the armature we have a two-pole shunt dynamo.
13. Corresponding to 12 we have a bipolar shunt motor.
14. A bipolar series dynamo.
15. A bipolar series motor.

In all the above cases the machines are self-excited and a large number of changes could be made by various combinations with separately excited fields, a number of which are outlined as follows:

16. By the use of two of the insulated rings we may have a four-pole alternating current single-phase dynamo.
17. Corresponding to this we have a four-pole single-phase synchronous motor.
18. By changing the armature winding again we may have a two-pole single-phase alternating current dynamo.
19. And corresponding to this a two-pole single-phase synchronous motor.
20. By the use of four of the rings we may have a two-phase four-pole alternating current dynamo.
21. By an adjustment of the rings a four-pole three-phase alternating current dynamo is procured.
22. Corresponding to case 20 we have a two-phase alternating current motor.
23. Corresponding to case 21 we have a three-phase alternating current motor.
24. By the use of the two pole armature winding we may get a two-phase two-pole alternating current dynamo.
25. Also a three-phase two-pole alternating current dynamo.

In all cases when the machine is used as an alternating current dynamo or motor, the fields will have to be separately excited. The armature and field coils winding may be made with larger or smaller wire than is sent with the machines, so as to employ higher or lower voltages and more or less current. The machine is very well adapted for a two or four-pole plater. In connection with the machine, instruction diagrams of field and armature windings and connections are given which make possible the above mentioned variations.

The volts and current produced by a winding of various sizes of wire is also given. More can be learned about the volts and current produced by a dynamo by making the changes required to transform this machine than in any other way.

Our students require this unwound. The experience gained in winding and connecting, which is a part of our course, is invaluable.

Some suggestions for an inexpensive foot-power device will be sent with every machine, for those who have no power with which to drive a dynamo.

DESCRIPTION OF COMBINATION MEASURING INSTRUMENT.

In this instrument an annealed soft iron core is drawn into a magnetic field obliquely. To accomplish this the spool on which the coils are wound is made with an oblong opening the height of which is four or five times its breadth. This allows the core the necessary freedom of motion. By the proper adjustments the direct reading scales can be made quite uniform from one end to the other. It will be seen that there are no multiplying devices to get out of order, the only motion being the movement of the core and pointer on their support. The instrument is wound with two coils, one of fine wire and the other, of coarse.

The coarse wire is connected between the two large terminals and the small wire between the small binding post and the large one next to it. The four scales are obtained from the two coils in this manner.

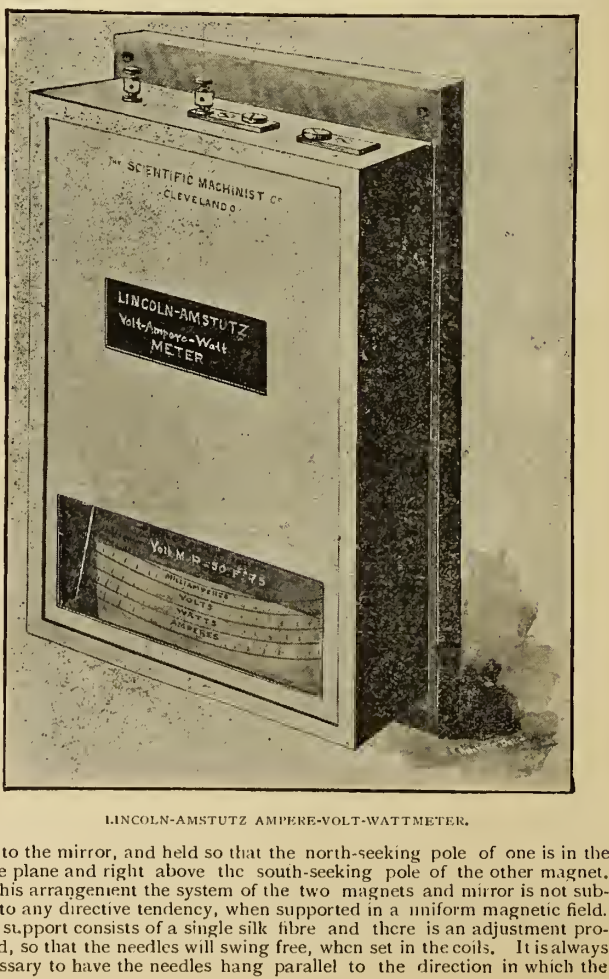
1. The ammeter scale is calibrated with a Weston ammeter in series with the coarse wire coil.
2. The voltmeter scale is calibrated with a Weston voltmeter in parallel with the fine wire coil.
3. From the known resistance of the fine wire coil and the volts at its terminals the fractional part of an ampere in the fine wire coil is found and given on the scale of milli-amperes.
4. Both coils are connected to the circuit at the same time, a wire from one side being lead to the middle binding post; the current then flows through the coarse wire coil to the lamps and to the other side of the circuit. Another wire from the small binding post is carried to the other side of the circuit so that the fine wire coil is in parallel with the coarse wire coil and the lamps, and is subject to the same voltage as the lamps. Both the fine and coarse wire coils tend to draw in the iron core and by proper calibration the watts are read.

Gravity is the force opposing the magnetic pull, and in setting up the instrument care must be used that the pointer stands at O.

REFLECTING GALVANOMETER.

The galvanometer offered herein is an astatic instrument with a resistance in the coils of about $\frac{1}{2}$ ohm, and may be called a reflecting galvanometer of low resistance. It is adapted for the detection and measurement of low electromotive forces, and will be found of special use in the measurement of current produced by thermal electrical action and currents produced by induction in the earth field. It is especially adapted as galvanometer in use in Wheatstone's bridge.

The piece is not highly finished or polished, but has all the essential elements of instruments listed by Queen & Co., at $100.00. The lens which is adjustable is provided to concentrate the light from the lamp upon a little revolving mirror. The system to which the mirror is attached is made up of two small magnets, one inside the coil and one outside the coil, magnetized to precisely the same strength and rigidity, attached to each other and to the mirror, and held so that the north-seeking pole of one is in the same plane and right above the south-seeking pole of the other magnet. By this arrangement the system of the two magnets and mirror is not subject to any directive tendency, when supported in a uniform magnetic field. The support consists of a single silk fibre and there is an adjustment provided, so that the needles will swing free, when set in the coils. It is always necessary to have the needles hang parallel to the direction in which the



LINCOLN-AMSTUTZ AMPERE-VOLT-WATTMETER.

wire on the coils is wound, when the needles are at rest. The same experiments may be performed with this instrument, as can be performed with more expensive instruments. It is in fact almost if not quite as delicate as a more expensive instrument. For instance, a piece of German silver and iron wire can be connected to the terminals of the instrument, and the junction of the silver and wire heated between the finger and the thumb, when sufficient current will be produced to give a decided deflection. Second: A coil of wire two or three turns, 1 foot in diameter, can be made up, and if the coil is reversed suddenly in the earth field, the induced current will give a very decided deflection.

For experiments in unipolar induction, this galvanometer can be used, for currents which are one hundred times smaller than can be detected on a calabrating coil of a Weston voltmeter.

In setting up the instrument, select a lamp of such height, that the flame will be approximately at the same height, that the mirror on the galvanometer and lens are. To get the best results the lamp should be covered with a tin hood or round paste-board box, with a hole cut in it, so as to allow a beam to strike the lens. This beam will be focused on the mirror by the lens and be reflected by the mirror on the screen, or what answers equally as well, the white wall of the room. It will now be seen that if the mirror is moved ever so little, the spot of light will be moved on the wall a considerable distance.

Two spots are provided in the instrument so that no more than a certain deflection can be obtained.

In order to get the instrument as delicately adjusted as possible, a magnet should be so placed in the neighborhood, that the length of the swing of the two little magnets and mirror is as great as possible.

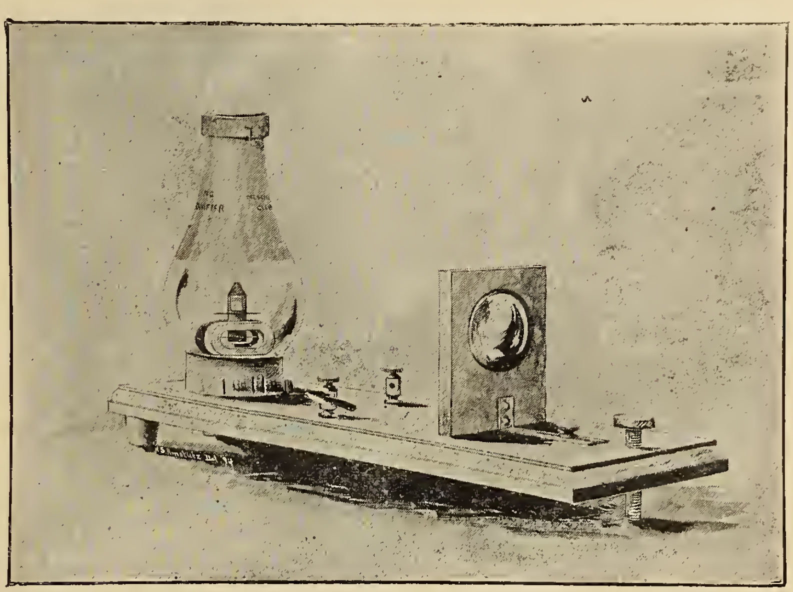
That is, if the field is adjusted, so that the time of the swing from one extreme to the other is $\frac{1}{2}$ sec., the instrument is only one-half as delicate as it would be if the time of the swing was 1 sec.

For investigation of small electro-motive forces, and for use as galvanometer on Wheatstone's bridge, this instrument we believe will be unexcelled. —The SCIENTIFIC MACHINIST CO., Cleveland, O.

SOME DATA ON THE COST OF TELEPHONE WORK IN NEW YORK CITY.

THE Metropolitan Telephone and Telegraph Company furnish the following interesting information with regard to certain features of their New York Telephone System and the Broad Street Exchange:—

The Broad Street Exchange, which serves the district bounded by Wall street and Broadway from Wall street to Battery, is the eighth central of the New York telephone system. It is one of the four larger offices which have been placed in fire-proof buildings specially constructed to contain telephone centres. In every feature it represents the most modern development of telephone engineering, and so rapid has this development been, that in no single item of its equipment does the Broad Street Exchange resemble the equipment of a telephone exchange of four years ago.



LINCOLN REFLECTING GALVANOMETER

As an illustration of the continual reconstruction of a large telephone plant that is rendered necessary by the constant improvements in apparatus and methods produced in response to the continual demand of the public for increased telephone facilities and for perfect service, the Eighteenth street Exchange is a case in point. This exchange was recently moved to a new building, and to effect the removal an entirely new central office equipment was constructed, and the equipment of the old office, which had been in service a *few days more than four years* was abandoned and the greater part of it was sold as junk.

The Broad Street Exchange at present supplies telephone service to some 1,100 subscribers, all of whom have been transferred from the Cortland street office, which, until lately, served nearly 5,000 subscribers and was overcrowded. The ultimate capacity of the Broad street office is for 3,000 subscribers. It contains the last type of metallic circuit multiple switchboard, a notable feature of which are the ingenious self-restoring indicators. These indicators return to their normal position automatically, thus relieving the operator of two manual operations, and consequently quickening the service.

During the past year or two improved methods of construction of lines and the placing of underground cables have been pushed with great vigor, resulting in the removal of old overhead wires and their substitution by copper metallic circuits throughout. In the Broad street district few old sytle lines now exist, and not a single wire enters the exchange overhead. All the subscribers' lines are brought into the building through the basement in lead covered cables, each containing fifty metallic circuit conductors. At the ends of the cables the conductors are connected to lightning arresters, which prevent dangerous currents from reaching the switchboard apparatus. The conductors next pass through a special switchboard or connecting rack where they make their union with the wires of the operating switchboard proper. This connecting rack is designed to allow of the junctions between the subscribers' lines and the switchboard being interchanged whenever necessary, and gives great flexibility in the apparently complicated system of wires.

Special features of interest are the generating plant, where current is produced for charging the switchboard transmitters and for ringing the subscribers' bells; the desk of the "wire chief" is provided with the apparatus for testing the subscribers lines and locating "troubles;" the desks of the monitor and exchange manager, are equipped with lines running to all parts of the switchboard to enable proper supervision of the operation to be maintained.

The telephone system of New York City consists at present of eight exchanges, equipped with metallic circuit multiple switchboards, having a total accommodation for 15,000 subscribers, upwards of 9,600 subscribers' stations, 800 private line stations, and 20,000 miles of underground wire. The entire system is constructed on a basis of exclusive metallic circuit working. About sixty per cent. of the subscribers now have metallic circuit lines and equipment, and the conversion from the old style grounded lines to metallic circuits is progressing with great rapidity.

With a metallic circuit line and office equipment a New York telephone subscriber can talk from his own desk to any one of upwards of 100,000 telephone subscribers in other cities, some of them over a thousand miles distant. The extraordinary development of telephony in America is in striking contrast with the state of the art in Europe, where subscribers can get only local service for their own instruments, and, to use a long distance line, must go to the terminus of the line, making an appointment with the distant correspondent first by telegraph.

There are between 80,000 and 90,000 conversations by telephone each day in New York City, and the average use of the telephone by each subscriber is 16 times daily. Many busy subscribers use their telephones from 100 to 200 times daily.

For the entire system there are over 400 lady operators. About 250 are on duty at the switchboards at the same time. The average number of connections made daily by each operator is a trifle under 400. At every exchange, comfortable sitting rooms, provided with lockers, tea and coffee urns, etc., are established for the use of the operators when not on duty at the switchboard.

A peculiar feature of the daily business of a telephone exchange is its enormous fluctuation. Although the service is permanent, the greater proportion of the twenty-four hours' work is compressed into two periods of about two hours each. In order to cope with these high pressure periods without delay in the service the entire plant and personnel of the system have to be organized as if the whole of the day's work were on the same plane. Besides the operators there is at each exchange a skilled force of electric wiremen constantly engaged in making connections and keeping all parts of the plant in sufficient working order. None but skilled labour is employed in any part of the telephone system.

The working force needed to maintain the telephone service consists of about 1,000 persons, an average of one employee to every nine subscribers. The technical work is carried on by departments, each having a large force of men under a responsible head. Some idea of the amount of construction work done can be gained from the fact that during 1893 more than 3,000 lines were built and an equal number of stations equipped, and more than 2,000 disconnected and removed.

AN engineer observed his steam gauge indicating a higher pressure than his safety valve spring was set for. He slackened the spring, but the gauge kept rising and the steam did not blow off. When the pressure rose to 200 pounds he became alarmed; and as he could not start the engine he started the injector and opened the water blow-off cock. The damper being closed, this had the effect to prevent further increase of pressure. On examining the safety valve it appeared that the brass seat of the valve was a bushing put into an iron casting, that it had become loose, and that the steam had pressed it up against the valve. As the valve rose the seat followed it, and there could not have been a release of steam until the bushing was pushed out of its hole.

ELECTRIC RAILWAY DEPARTMENT.

PORT ARTHUR ELECTRIC RAILWAY.

THE Port Arthur Electric Railway is the only street railway in America that is owned and operated by the town, and it is an interesting experiment in municipal undertakings to see what the outcome of this venture will be as far as the feasibility of towns operating their own railways.

When Fort William started to build up under the favorable auspices of the Canadian Pacific Railway, better communication was required between the two towns. For years stages in winter and steam ferries in summer, with probably three or four trips per day, were found quite sufficient for ordinary local travel, and people paid cheerfully twenty-five cents for the privilege of making the trip either by wagon or boat. It was found that this would not do for increased travel; then the question was, what would be the best method of improving it, and it was considered that as the enterprise for some little time would not be a paying one, the proper method would be for the town of Port Arthur to build the railway itself, so that whatever little loss there might be in operating it, would be borne by all the taxpayers who were benefitted.

Power House, Port Arthur Electric Railway, Showing Water Power Available.

The people originally voted seventy-five thousand dollars, which it was considered at that time would be sufficient to complete the railway, not only to Fort William, but to West Fort William.

However competent municipalities may be to manage monopolies, they were not so competent to construct them, and the money originally voted did not do as much work as might reasonably have been expected.

After voting the money the most serious question that the municipality then had to tackle was the question of getting into Fort William. The people of Fort William thought that the building of the railway was going to be to their detriment rather than to their benefit, and legislation had to be secured. This delayed the completion of the railway a year. The people of Fort William made it a sine qua non that the railway should be built not only to Fort William, but through to West Fort William, and that the rates of fare over the line for a continuous trip should not exceed 5 cents single fare, 6 tickets for 25 cents, 8 workmen's tickets for 25 cents, 10 school children's tickets for 25 cents. Forty thousand dollars more was voted to complete the railway and to put it in first class shape. This was done last October, and it has been continuously operated ever since.

Port Arthur Electric Railway, through Port Arthur.

During the winter season a round trip an hour is made between Port Arthur and West Fort William, and in summer three trips in two hours, between six o'clock in the morning and midnight. The average number of passengers carried daily is about one thousand, and however much the Fort William people may have objected to the building of the railway at the start, they find now that it is a great benefit as well as a great convenience.

The power house is situated at Current river, about one and a half miles east of the eastern terminus of the railway, and at present electricity is generated by steam. However, on Current river at this point, within 2000 feet, there is a fall of 80 feet; 40 feet of this can be very easily utilized at an expenditure of some $20,000. That would give ample power to operate not only the railway but an electric lighting plant as well, and it is expected that the town will improve the power, put in a lighting plant, and operate both it and the railway with the power there generated. This, however, will hardly be done this year, and it may not be done at all by the municipality, as the opinion of the ratepayers at present is that it would be better to get the railway out of the arena of municipal politics by leasing it for a term of years to some company or individual who would furnish a service equal to that now furnished by the town.

The system of operating the railway is, that the receipts are paid over to the town treasurer, who furnishes the conductors with tickets; the superintendent has charge of the operating department and maintenance, and the general supervision of the whole matter is under the control of the chairman of the Railway Committee, who likewise is responsible to the Council.

The railway in its entire length is about seven and six-tenth miles. It starts at the Canadian Pacific Railway station in Port Arthur, thence along Cumberland street, the main street of the town, to Fort William road. When it reaches the Fort William road the track is elevated, the same as an ordinary steam railway, in order that there may be less trouble with snow in winter; this elevation continues until it reaches Simpson street, the main street of Fort William, along which it runs. From Fort William to West Fort William the railway is laid along the travelled highway, and it terminates very close to the Canadian Pacific and Port Arthur, Duluth and Western Railway stations.

The equipment consists of three Patterson & Corbin 18 ft. vestibuled upholstered cars—electric head and interior lights; electric bells and heaters; Bennis trucks and elliptic springs. Two of the cars are equipped with two No. 14 20 H. P. Edison motors to each car, and one with one 30 H. P. No. 800 G. E. Co.

motor. There is also one 12 ft. flat car for freight and construction use.

The cars have averaged about 200 to 240 miles each per day, and have been singularly exempt from any accident.

The car barn is a handsome structure 120 × 50 feet, with offices, repair shop and storage rooms, space for 6 cars, electric lighted, and situated in the centre of the town.

The power house is a frame structure 75 × 75. The engine is a Wheelock 150 H. P. compound condensing, with boiler to suit —all set on massive stone foundation—the whole work being laid with Portland cement. The generator is the Edison 45,000 watts, No. 16.

The road is 4 ft. 8½ in. gauge, 40 lb. T rails (steel), with ties, two foot centres, planked on each side of rail and well ballasted. Two Johnston spring turnouts are used, also one patented railway crossing or diamond. In crossing the Port Arthur, Duluth & Western Railway, a metallic telephone circuit connects with power house from Fort William terminus of line; also turnouts and car barn.

The overhead construction is of a very elegant and substantial description, double poles being used through both towns, with brackets on single between the towns. The trolley wire is No. 4 B. & S. hard drawn copper, the current being fed to it every fifth pole (600 feet) from a No. 1 insulated feed wire, Edison system; also a second feed wire, No. 00, is run direct from the power house to a point about ⅔ the total length, where it feeds directly into other, all being well protected by 8 Watson lightning arresters.

QUESTIONS AND ANSWERS.

Edgar Carr, Electrician for the Brockville Light and Power Co., writes: In this power house they have one Ball and one Reliance machine. At times the Reliance works all right at commencement of run, but after three or four hours work, begins to cut and spark. This cannot be caused by uncleanliness, as both commutator and brushes are cleaned and intently watched. Sometimes the machine runs all right for a week or two, and then commences to act as before stated. This occurs when both machines are running at the same time. The Reliance machine acts all right when run alone. What is the cause of the difficulty, and what the remedy?

Port Arthur Electric Railway—Construction between Port Arthur and Fort William.

ANSWER.—The Reliance Electric Mfg. Co., to whom we referred the above enquiry, write us as follows:—Re Brockville dynamo sparking, you failed to state whether dynamos were run in series or multiple; we take it that the latter is the case, and each dynamo is supplying a separate current. The trouble only occurs when both machines are running; when run alone the Reliance machine does its work properly; in this case it must be influenced in some way by the other machine. It would therefore appear that the machines were set too close together, and that one had a stronger field than the other, which would have an influence over the weaker machine, and thereby distort its field circuit, causing it to spark, or there might be a ground between the line or machines in such a way as to cause an excessive current to flow through the armature of the dynamo complained of.

"W. N.," Hamilton, Ont., writes: Would you please answer the following questions: (1.) What size storage battery would I require to run 20 incandescent lamps with a voltage of 110 ½ ampere per each lamp, to run 5 hours? What would be the cost of such a battery? Also how long would the same battery run a one-horse power motor? (2.) Would it be possible to regulate the voltage on the lamps separately while running lamp and motor off the same dynamo at the same time and still retain the proper voltage on the lamps? Please furnish rules and examples with your answers to these questions.

ANSWER.—(1) Storage batteries are rated in ampere-hour capacity per cell, and each cell, of the usual type, gives 2 volts. 20 lamps ½ ampere each take 10 amperes current; to run them 5 hours would therefore require "50 ampere-hour" cells, and 55 such cells would be needed to give 110 volts. 50 ampere-hour cells would cost about $9.00 each. These small sized cells are relatively more costly, and you could, at less expense, use for 20 lamps of 1½ amperes, and 40 volts each, a battery of twenty 150 ampere-hour cells, costing about $19.00 per cell. A motor which would give out 1 horse-power for 5 hours continuously would take the same size battery as required for 20 lamps for 5 hours. (2) You could only do so by using a resistance in series with the lamps or the motor in series with whichever of the two needed the lowest volts, and varying the resistance to absorb the difference between the volts required and volts given by the dynamo.

SPARKS.

The courts have granted an order for the winding up of the Toronto and Richmond Hill Street Railway Company.

The Hamilton City Council will endeavor to compel the local Street Railway Co. to put vestibules on their cars.

The name of the Moncton, N. B., Tramway Co. has been changed to the Moncton Street Railway, Heat and Power Co.

Experiments are being made at Hamilton, with the transmission by means of a third rail, instead of the overhead trolley, of electricity for street railway purposes.

The Montreal Street Railway Co. are said to have in contemplation the erection of a large power house in the centre of the city, with land sufficient for tracks and car barns.

On the 27th of June, conversation was successfully carried on between London, Ont., and New York, over the new metallic circuit recently completed by the Bell Telephone Co.

In response to a petition from a number of citizens, the Hamilton Street Railway Co. have consented to establish a limited Sunday service. If the service can be made to pay, it will be continued, but not otherwise.

The Council of Calgary have granted a five years' contract for street lighting to Mr. P. A. Prince. The contractor agrees to furnish twenty-five 1200 C. P. lamps at $7.00 per month each, with a discount of fifteen per cent. for prompt payment.

The G. N. W. and C. P. R. Telegraph Companies are receiving well-meried tpraise for the expedition with which the election returns were collected from all parts of the Province. The returns from nearly all the constituencies were in before 9:30 p.m.

The great chimney in connection with the Toronto Railway Company's power house has been finished. President McKenzie and several officers of the company ascended to the top of the chimney, a height of 375 feet, for the purpose of laying the finishing brick.

A franchise has been granted to Messrs. Legier & Sons to build and operate an electric street railway, and to supply light, heat and power in the city of Belleville, Ont. Construction work will begin at once and the road is expected to be in operation by the end of the year.

The Toronto Railway Co. express their intention to extend their Mimico line westward to Oakville, and possibly through to Hamilton. Residents along the route of the proposed extension are arranging for meetings to ascertain what amount of financial support could be secured for the project.

The London Street Railway Co. is reported to have made another offer to the City Conncil for the privilege of running electric cars over the streets of that city. The offer includes eight fares for a quarter. This is certainly a most liberal offer, and one which the Council would do well to accept.

As a result of the recent amalgamation of the Winnipeg Street Railway Co. with the Winnipeg Electric Street Railway Co., the former company are endeavoring to arrive at an understanding with the Council regarding their proportion of taxation for street pavements and the removal of their horses from the streets.

Mr. Cunningham, chief engineer of the Montreal Street Railway Co., proposes a system of delivery of mail matter to the city suburbs by means of electric mail cars, specially constructed for the purpose. The Postmaster of Montreal is said to have approved of the idea, and the Government is said to be willing to adopt the new method.

The Hamilton, Grimbsy and Beamsville Electric Railway Co., are still having difficulty in securing right of way for their line. Some of the property owners along the route are evidently trying to force the company to pay them an exorbitant price for their land, but the courts are in some instances discounting the claims by 75 per cent. and upwards.

The annual report of the Chaudiere Electric Light Co. shows that there were installed during the last year, 8,000 lights, the company having in operation a total of 26,000 lights. The following gentlemen were re-elected directors of the company:—Messrs. Brophy, Soper, McRae, Ahearn, Workman, R. & W. G. Hurdman, W. Scott and W. Hutchinson. A dividend of eight per cent. was declared.

The recent meeting of the American Society of Mechanical Engineers in Montreal, was one of much interest. There were between two and three hundred of the members of the Association in attendance. The papers and discussions were of a most valuable character. As usual, the citizens of Montreal tendered their warmest hospitality to the visitors. Addresses of welcome were presented by the Canadian Society of Civil Engineers, and the Canadian Association of Stationary Engineers.

The illustrated article under the heading "An aid in Educating Motormen," which appeared in the ELECTRICAL NEWS for June was copied from the Street Railway Review of Chicago, but through an oversight proper credit was not given to that journal.

CAR TEST.

By W. F. McLaren and J. H. Meikle, Jr.

On Monday, 26th March, we made a test of one of the cars belonging to the Hamilton Street Railway Co. We had a special car for the purpose, and Mr. W. W. Dean, the electrician, acted as motorman.

The results of the test are shown in the accompanying table. The great bug-bear of car-testing is the accurate determination of the speed. This was done as accurately as possible by counting poles passed in each ten seconds during the run, poles being spaced about 40 yds. apart. Readings were taken every 5 secs on the following instruments: a volt-meter between the trolley wire and rails, a volt-meter between the brushes of one of the motors, and a mili-volt-meter, graduated in amperes and attached to the terminals of a 200-ampere shunt, which was connected in the main trolley circuit.

Only those parts of the run where most reliable readings were obtained are shown in the table, average volts and amperes being used in the computations. The armature resistance is .52 ohms. Knowing this we were able to calculate the drop in the armature, and determined the counter e. m. f. by subtracting this drop from the brush volts. The ratio of the counter e. m. f. to the brush volts gives us the motor efficiency. The computation of traction effort is based on the assumption that a pull of 20 lbs. per ton is required to keep the car moving at a uniform speed on a level; the necessary increase being added for grades. Let W = weight of car and passengers in tons, and P = % of grade.

RESULTS OF CAR TEST.

STREETS.	Grade %	Feet per minute.	Miles per hour.	Average Current.	Trolley Volts.	H. P. Supplied.	Brush Volts.	Drop in Armature.	Counter E. M. F.	Traction effort lbs.	H. P. developed.	Torque ft. lbs.	Efficiencies. Car.	Efficiencies. Motor
Emerald to Wellington on King..	2	1400	15.9	38.4	437.5	22.5	407.5	10.0	397.5	336.0	14.25	164.5	63.4	90.8
McNab to Bay on King.........	.6	1100	12.5	44.2	427.2	25.3	391.1	11.5	379.6	179.2	5.97	87.8	23.6	88.8
Bay to Caroline on King.........	.8	1100	12.5	41.0	415.0	22.8	375.0	10.6	364.3	201.6	6.71	98.8	29.4	87.9
Caroline to Queen on King......	2.7	1100	12.5	52.8	403.9	28.5	357.3	13.7	343.6	414.4	13.78	203.0	48.3	85.1
Queen to Pearl on King.........	1.3	900	10.2	53.6	418.0	30.0	373.0	13.9	359.1	257.6	7.02	126.0	23.4	96.3
Oak to Hannah on Locke........	1.3	1000	11.4	54.8	409.8	30.1	352.8	14.2	338.6	257.6	7.80	126.2	25.9	82.7
Caroline to McNab on Herkimer.	1	1300	14.8	40.2	429.7	23.1	393.3	13.5	379.8	224.0	8.82	109.7	38.1	96.5

Average car efficiency, 36%. Line, 80%.
Average plant efficiency (from coal to generators) 6.83%.
Total efficiency of system 1.95%.

STARTS.

STREET.	Grade %	Maximum current.	Trolley Volts.	H. P. supplied.	Traction effort.	Torque.
Ferguson on King............	2	77	420	43.3	616	302
James and King..............	.6	77	445	40.5	459.2	225
Main and Margaret..........	0	83	425	47.3	392	192
Main and Locke.............	0	103	405	56.0	392	192
Herkimer and Locke....... ..	0	117	410	64.3	392	192
Queen and Herkimer.........	1	137	400	73.5	504	247
King and James..............	0	77	442	45.6	392	192

Then traction effort $= W \times 20 + W \times 2000 \times \frac{p}{100} = W \times 20\,(1 + p)$

For starting torque we use 70 lbs. per ton and have

$$W \times 70 + W \times 2000 \times \frac{p}{100} = W\,(70 + 20p).$$

We estimated the weight of the car and the passengers to be 5.6 tons.

The horse power expended in moving the car is:

$$\frac{\text{Traction effort} \times \text{speed in ft. per min.}}{33000}$$

The horse power supplied being determined from the amperes and trolley volts, we get the car efficiency from the ratio of these two. The total torque on each armature is measured by half the traction effort multiplied by the radius of the armature in feet. This radius was .98 ft.

On 27th March we weighed the coal used during a 12 hour run, and also read the ammeters every two minutes during this time, and the volt-meter every ten minutes. The amount of carbon in the coal was afterwards determined by a chemical analysis. Thus, knowing the amount of carbon supplied to the furnaces, and assuming 14500 B. T. U. per lb. of carbon, we can compute the horse-power supplied. Taking average volts and amperes, we get the electrical horse power generated. From the ratio of these we determined the plant efficiency to be nearly 7%. From the ratio of the average trolley volts read on the car test to the average volts read at the station, we determined the line efficiency to be 80%. The average car efficiency being 36%, we get about 2% for the efficiency of the system.

The trolley on the car tested was not in very good shape and the wheel frequently came off the wire on curves. The large starting currents shown on the table were obtained in starting on curves, and though these stops were accidental, yet they serve to show the danger of stopping a car on or at the beginning of a curve.

THE CONSTRUCTION OF STREET CARS.

In the construction of street railway cars it is desirable to employ the least amount of material, which will give the strength required in the work for which it is intended. Any superfluous weight has not only its effect on the motive power, but on the roadbed as well, and consequently makes a difference in the dividends at the end of the year.

A recent article by John C. Henry, contains some very valuable matter on this subject, in which he says in substance: The omnibus is constructed to shelter passengers and stand the vibrations incident to a rough road. They are built as commodious and light as possible. Sleeping cars are built to stand a high speed, to roll over embankments without breaking to pieces and to stand the kicks and jerks of a 1,000 horse power engine. The modern electric car is a cross between the two. In the construction of the street cars which are required to stop and start frequently, to lift themselves up steep grades, I think the lines of the omnibus should be observed, more particularly in the roof. If it is light, the walls and sides may also be. The city of San Francisco leads the way in mechanical street car traction. Their cars are admirably adapted for electric motors and are known as combinations. The earlier built were remodeled horse cars. The managers took the ordinary 14 foot horse cars, removed the platform and hood from one end and built a light 14 foot addition thereto. The new part was open with a passage way down the centre and the seats placed lengthwise, the passengers facing outward; these car bodies weigh about 7,000 lbs. and are mounted on light double 26 inch trucks. When mounted they weigh from 10,000 to 11,000 lbs. Their weight is distributed on eight wheels; taking the maximum estimate of their weight makes the weight on each wheel but 1,375 lbs. By adding a 30 horse power motor and placing it on the forward trucks, would give a pressure on the rail not to exceed 1,700 lbs. per wheel.

There are in many places to-day four wheel electric street cars that weigh empty not less that 10 tons, with a wheel pressure of 5,000 pounds, or almost twice that of a standard freight car. According to a law in mechanics this four wheel car injures the track seven times as much as the San Francisco style with motor. When the rolling stock is properly designed and the joint ties are supported on concrete, a 35 pound girder or T rail is all that is necessary for ordinary street railway purposes.

The combination car has nearly double the carrying capacity of the four wheeler referred to, and weighs nearly three and one-half tons less. If the estimate is correct, that it takes two cents per ton per mile to move this superfluous weight, and the mileage is but 100 per day, there would be a direct saving of seven dollars per day, which, multiplied by the number of cars and the average number of runs for a year, would make a large amount, representing the difference in the earnings of the road with the two styles of cars.

A SHORT LINE TELEPHONE.

The Rabbidge telephone has been brought before the English public, according to London Lightning. This telephone, it appears, is designed for speaking over short lines, such as would connect the different rooms in a large warehouse or block of buildings. The usual call bell is replaced by a small vibrating reed in the receiver, which, when the circuit is closed, gives a clear note, pleasanter than the sound of a bell. A small tube containing mercury automatically changes the connections when the instrument is inverted. This stops the sound and acknowledges the call, which is made by removing a plug from one hole to another. The act of inverting the instrument also tends to prevent packing of the carbon granules in the transmitter. The whole is so small that it can be conveniently screwed to the side of a desk, thus saving the trouble of moving to an instrument fixed to the wall.

By means of two telephones, one with a diaphragm, the other without, the speed of machinery may be indicated at a distance. The telephone without the diaphragm is placed with the pole of its magnet very near the iron arms of a revolving wheel, or it is placed near a wooden wheel carrying a number of armatures. As the wheel revolves, the arms or armatures in passing the pole of the telephone produce changes of magnetism which induce electric pulsations in the winding of the telephone magnet. These electric pulsations affect the strength of the magnet of the distant telephone, thus causing the diaphragm to vibrate, producing in the telephone a musical sound, the pitch of which depends on the speed of the machinery. The pitch being ascertained by comparison with a pitch pipe or similar instrument, the speed is found by a very simple calculation.

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We manufacture only the most modern and perfect machinery, and our standard of workmanship is the highest.

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SPARKS.

Mr. Herman Bunker, of Barrie, Ont., has been granted a United States patent on a clutch pulley.

The purchase of an electric light plant is under consideration by the Council of the Town of Kamloops, B. C.

The village Council of Streetsville, Ont., have given a contract to the Reliance Mfg. Co., for six arc lights.

A by-law will be submitted to the ratepayers of Kincardine, Ont., on the 9th July, to authorize a loan of $10,000 for the purchase of an electric light plant.

The first shipments of material for the new switch-board for the Toronto office of the Bell Telephone Co., have been received from the factory in Montreal.

Acting in accordance with authority conferred by Parliament, the Bell Telephone Co., have decided to increase their captial stock from $2,640,000 to $3,168,000.

Owing to certain municipal regulations, the Chambers Electric Light and Power Co., of Truro N. S., have been compelled to reduce the height of their building to one story.

The Physical, Chemical and Mathematical Section of the Royal Society of Canada, has elected as its President, Mr. B. J. Harrington ; Vice-President, Prof. H. C. Bovey, of McGill University ; Secretary, Mr. G. Devill.

The town Council of Orillia have accepted the tender of the Canadian General Electric Co., for an incandescent lighting plant, at the price of $9,450, and the tender of Goldie & McCulloch Co., for steam plant, at the price of $2,750. The acceptance of these tenders is made contingent on the approval of the ratepayers of a by-law appropriating $13,000 for the purchase.

The Queen Victoria Niagara Falls Park Commissioners have granted to the Canadian Niagara Power Co., a perpetual franchise for the use of the water power of the Niagara Falls on the Canadian side of the river, and have formally accepted the plans submitted by the Power Company for the development ot the water power, The site for an immense stone power house, similar in dimensions to the one on the United States side of the river, has been staked out on the side of the high bluff, under the Loretto Convent and Carmelite Monastery. The construction of the inlet canal, wheel-pit and tail-race tunnel will be immediately commenced. The company expect to be in a position a year hence to supply 15,000 H. P.

TRADE NOTES.

The Canada Coals & Railways Co., Joggins Mines, N. S., are putting in a 300 horse-power Lancashire boiler, fitted with Galloway conical tubes. It was built by the Robb Engineering Co., who have another of the same size under constructoin for them.

The Johnston Electric Co. have opened offices at No. 34 York street, Toronto, as electrical contractors and dealers in electrical supplies. Their specialties are a new slow speed alternating current dynamo ; a new arc lamp for alternating circuits, operated with or without transformer ; a new automatic arc dynamo, direct constant current ; railroad and stationary motors. Mr. W. A. Johnston, formerly manager of the Ball Electric Co., occupies a similar position with this new company.

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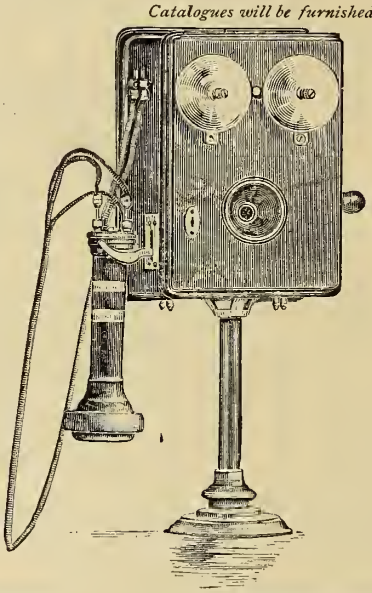
Catalogues will be furnished on application.



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PERSONAL.

At Cornell University, Commencement Day, June 21st, the degree of Mechanical Engineer was conferred on Messrs. W. F. McLaren, Hamilton, Ont., W. G. Krantz, Berlin, Ont., and J. H. Meikle, Morrisburg, Ont.; Thos. Hall, Washington, Ont., took the degree of Master of Mechanical Engineering.

The Hamilton, Grimsby & Beamsville Electric Railway Co., have appointed Wm. A. Sweet as their chief engineer. He comes to them highly recommended, having been employed by the Hamilton Vinegar Works Co. for the past four years. He is President of Hamilton Association No. 2, C. A. S. E., and a member of the Ontario Association of Stationary Engineers.

PUBLICATIONS.

With the June number the Arena opens its tenth volume, and is an especially notable issue. It contains over one hundred and seventy (170) pages.

An amply illustrated character sketch of Louis Kossuth appears in the May Review of Reviews. Besides portraits of Kossuth at various stages in his career, there are several reproductions of rare prints, representing battle scenes in the Hungarian revolution, which were suppressed at the time.

MONTREAL ELECTRIC CLUB.

The above Club, after having held a very successful series of meetings throughout the winter, have adjourned for the summer season.

SPARKS.

A metallic circuit is being constructed by the Yarmouth, N. S., Telephone Co.

Mr. Robt. Mainprize, of Wingham, will install an arc lighting plant at Goderich.

Mr. G. K. Nesbitt is installing additional electric plant in his mill at Cowansville, Que.

The extension of the North American Telephone line between Kingston and Smith's Falls, has been completed.

Incorporation is being sought for by the Stanstead, Que., Electric Light Co., with a capital stock of $25,000.

The ratepayers of London, Ont., are said to be in favor of accepting the company's recent offer for the construction of an electric railway.

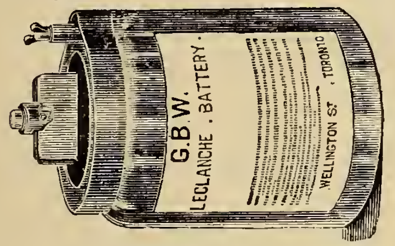
A by-law will shortly be submitted for the approval of the ratepayers of Collingwood, Ont., to anthorize the expenditure of $12,000 for the extension of the waterworks and electric light systems.

The Bell Telephone Company have commenced the construction of their underground system at Ottawa. 18,000 feet of underground cable, and 19,000 feet of aerial cable, will be used. As the result of the use of these cables, the number of overhead wires will be greatly reduced in the central part of the city.

The St. John Street Railway Co., has recently elected the following officers: Sir Wm. C. Van Horne, president; Col. Tucker and Messrs. James Ross, H. P. Timmerman and H. H. McLean, directors; Mr. F. A. Warren, secretary-treasurer, and Mr. C. D. Jones superintendent. It is the intention to entirely re-construct and equip the new road with new material. The work will be commenced at once.

Please mention the CANADIAN ELECTRICAL NEWS when corresponding with Advertisers.

THE GALVANIC BATTERY WORKS



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SPARKS.

The Brockville Light & Power Co. are applying for the contract to light the new asylum building. If their application is successful they will require a new alternator of at least 2000 lights capacity.

The Government are said to be looking out for a suitable site on the banks of the canal at Cornwall for an electric power station. When they have located one tenders will be required for the work.

The Reliance Electric Mfg. Co., referring to the paragraph in the recent issue of THE NEWS, which stated that an electric plant was required at Tilbury Centre, Ont., write that this statement is incorrect, as they put in a plant at that place in December last.

It is probably not widely known, says the N. Y. Electrical Review, that only seven out of the 17 transatlantic cables are now in use—10 having given out for various causes. Estimating the cost of each cable at $3,000,000, here is an irreclaimable investment of $30,000,000 safely buried beneath the ocean to a depth of from a few fathoms to over five miles.

There is one crudity about electrical work, says Power, which is perhaps more a problem for the electrician than for the engineer, and yet it is of interest from the power standpoint. A six hundred horse-power engine, for instance, is connected up to a six hundred horse-power generator. In case of an overload the engine could run up to eight or nine hundred horse-power, but when the electric load increases unduly the fuses blow or the circuit breakers drop, and that unit is dead until matters can be readjusted. It is as though a boiler were fitted with a fusible plug that would melt and put the fire out when the pressure got above the allowable limit. Cannot there be an electrical safety valve which will prevent a dynamo from furnishing over-much current without stopping it altogether?

POSSIBILITIES OF SPEED BY STEAM.

In his recent inaugural address, the president of the French society of civil engineers, M. du Bosquet, pointed out that express trains daily attain seventy-five miles an hour on down grades, providing that such speeds are not dangerous. But the engines are not sufficiently powerful to maintain such speeds on a level. A drawbar pull which would give seventy-five miles an hour on a down grade of one in 200 would give only fifty-seven and a half miles on a level, and thirty-one and a fourth miles on up grade of one in 200. A slight increase in the average speed greatly increases the power required. If 322 horse-power will draw a train at fifty miles an hour up an incline of one in 200, for a speed of 125 miles 2,960 horse-power would be necessary. High speeds, moreover, increase the weight of the engines per horse-power, and there is a limit beyond which the engines could not move themselves. At their maximum power, the modern French locomotives weigh about 158 pounds per indicated horse power; but a similar engine of 150 tons generating 2,000 horse-power, would be required to draw a train of 100 tons up a slope of 200. The highest possible speed for such an engine and train up the slope would be eighty-seven and a half miles an hour, and for this the engine would weigh 670 tons and would generate 8,932 indicated horse-power.

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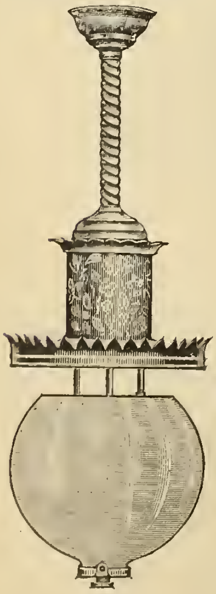

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Direct-Incandescent or Alternating Circuits.

IT IS WITHOUT A COMPETITOR ON ALL CIRCUITS SINGLY OR IN SERIES

It is not affected by the flashing of machine.

IT CAN BE REPAIRED BY ANY ONE.

It is much more reliable in action and would save the cost of patrolmen.

The energy expended on the electro magnets' mechanism to operate most arc lamps is utilized in THE EXACT to enhance its candle power. Its resistance is lower than any other lamp.

By using this lamp all the requirements of a city for power arc and incandescent lighting may be met by an alternating plant, thereby saving cost of direct generators, engines, shafting line construction and maintenance of same, thus reducing the cost of installing and maintenance nearly fifty per cent.

One lamp can be burned on a 5 light transformer and from 25 volts up.

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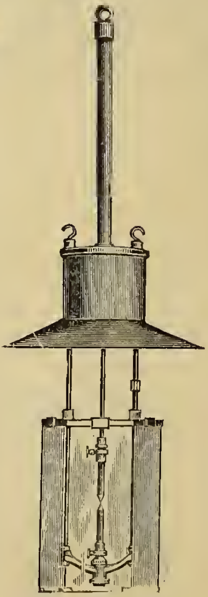

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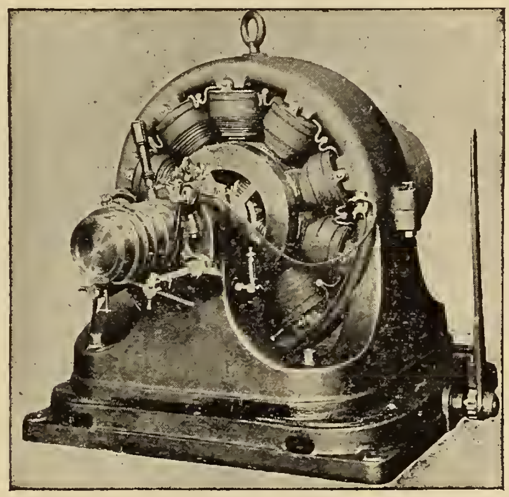

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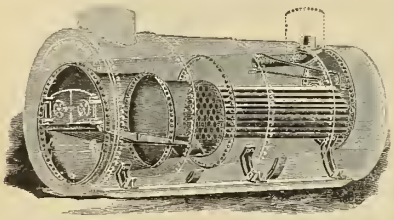

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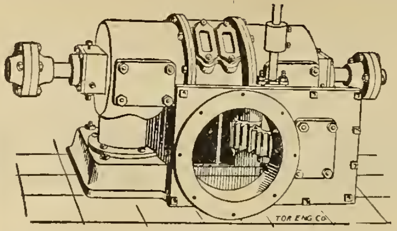

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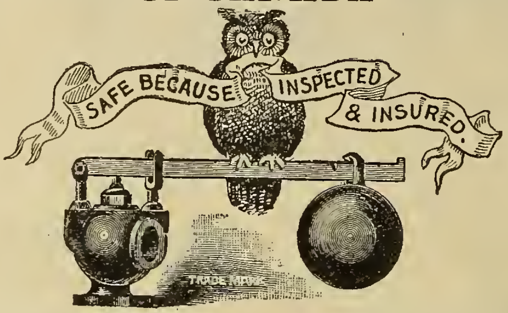

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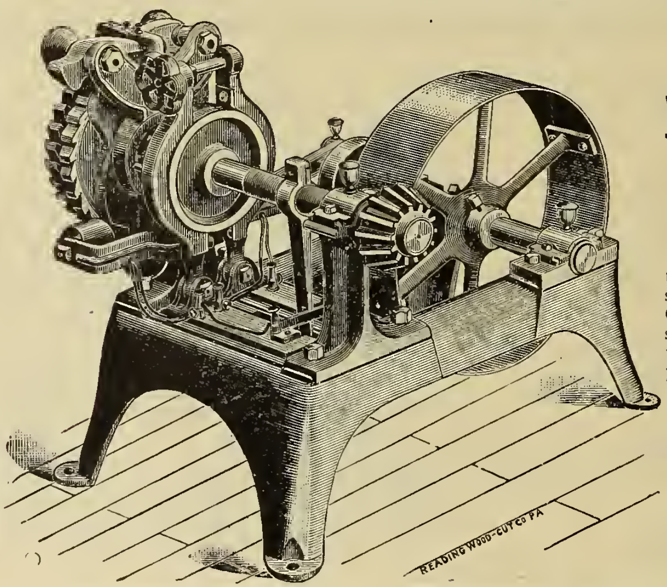

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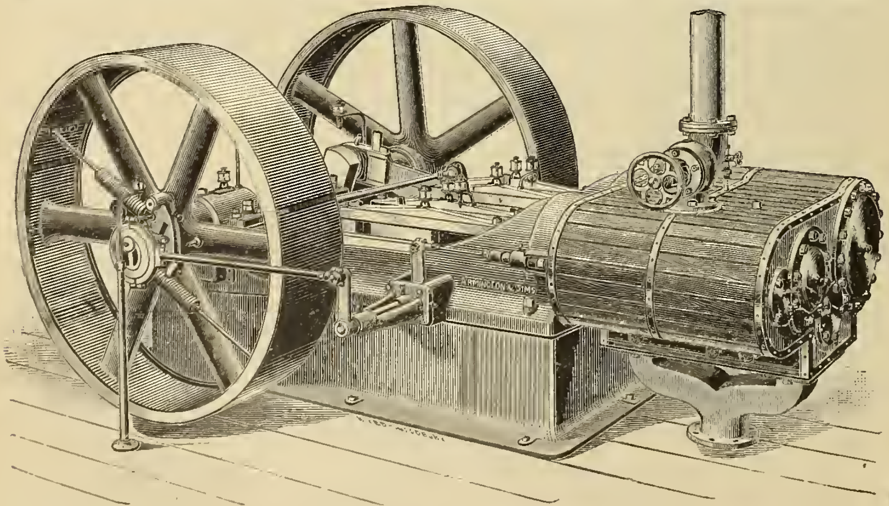

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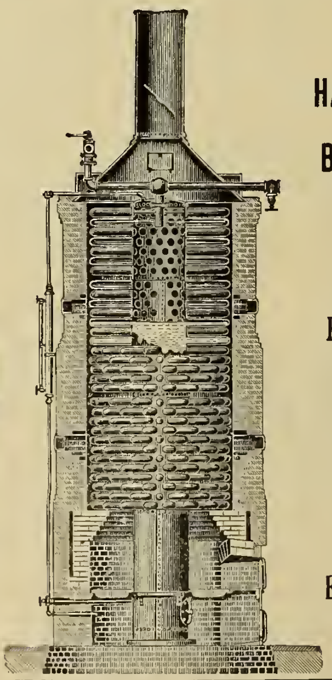
NOTICE.

The Canadian Locomotive & Engine Co., Limited, of Kingston, Ontario, have the exclusive license for building our Improved Patent High Speed Engine for the Dominion of Canada, and are furnished by us with drawings of our latest improvements.

PROVIDENCE, R. I., Nov. 18th, 1889. (Signed) ARMINGTON & SIMS.



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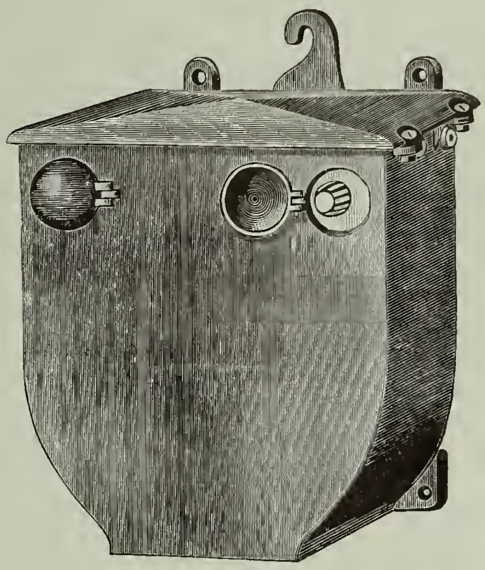

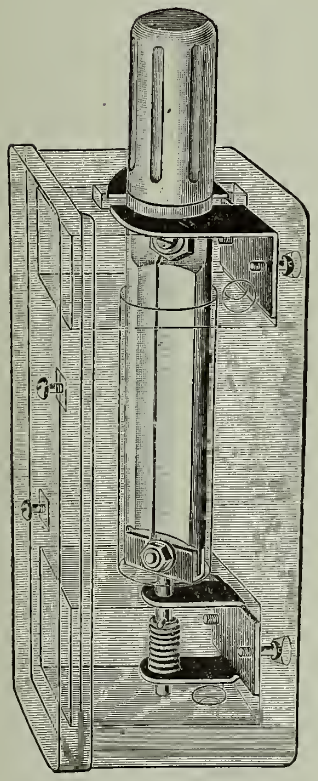

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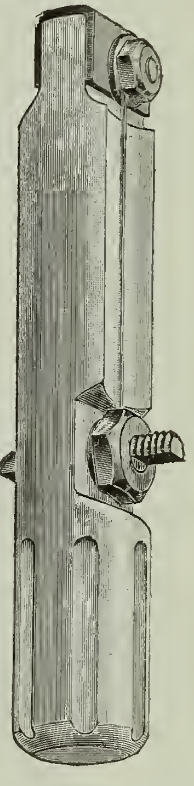

FUSE PLUG (¾ size).

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PERFECT INSULATION

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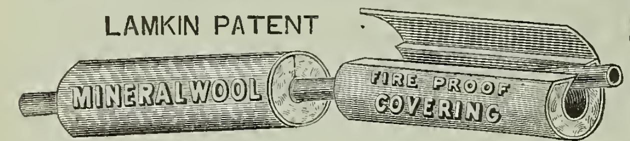

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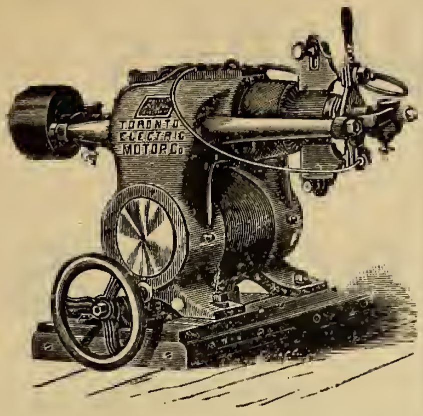
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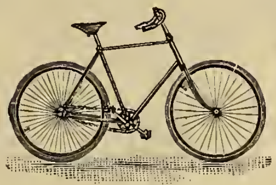

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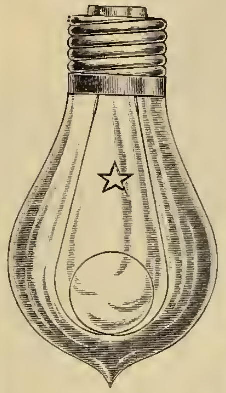

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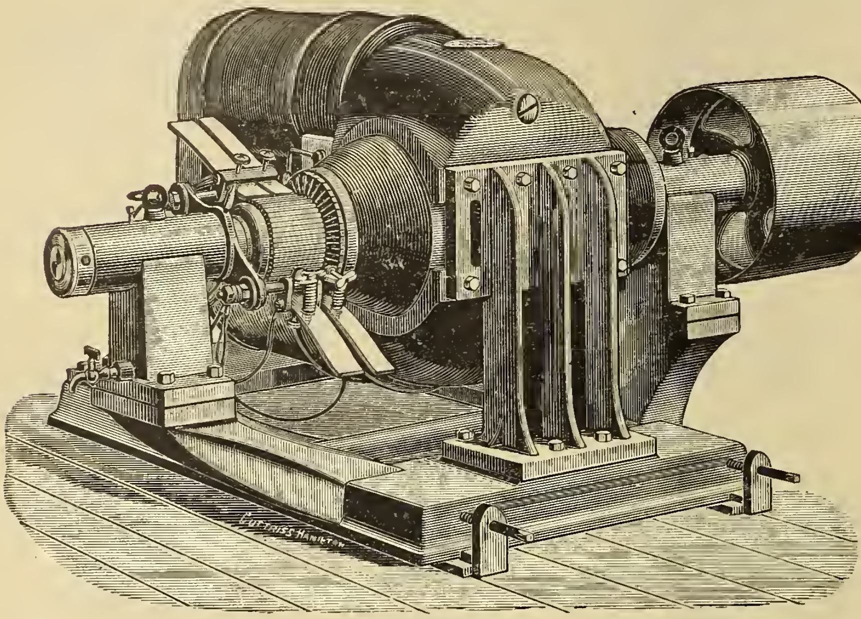

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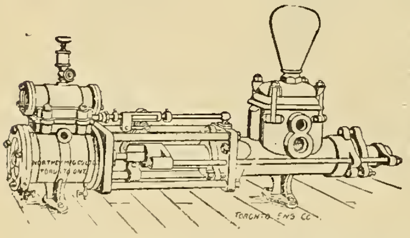

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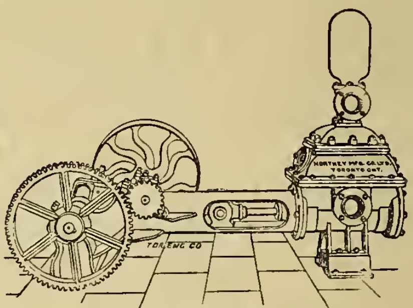

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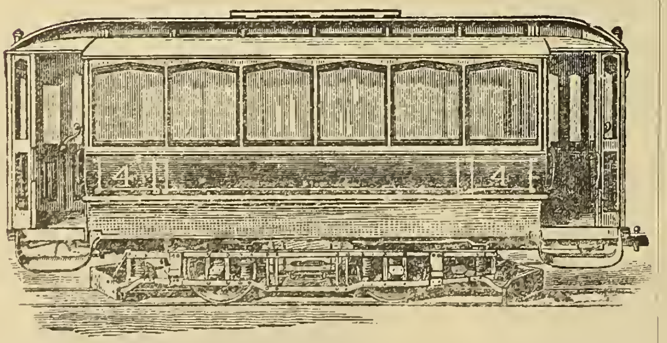

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CANADIAN
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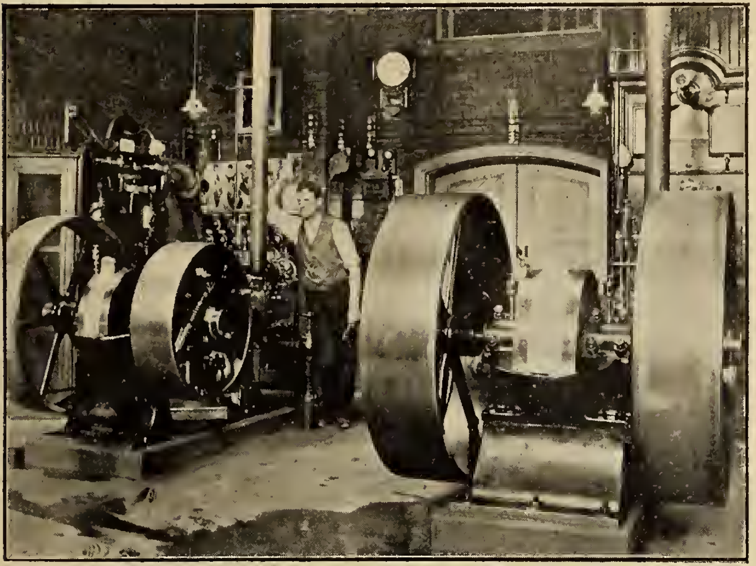
STEAM ENGINEERING JOURNAL.

VOL. IV. AUGUST, 1894 NO. 8.

THE ELECTRIC PLANT AT UPPER CANADA COLLEGE.

UPPER Canada College, Toronto, possesses as well equipped a modern plant as any private institution in Canada. The engine and boiler room are separate from the main building proper, and have splendid light and ventilation provided for those employed in that department.



VIEW OF ENGINE ROOM, UPPER CANADA COLLEGE, TORONTO.

The 800 lights used throughout the building and the current that is used for various purposes hereinafter described, is manufactured by two high speed engines of 40 and 80 H. P., which, by the aid of endless belts are connected direct to two Edison generators. From these machines the current is carried to a distributing cabinet and switch-board, thence to section switches, sixteen in number, from which lights can be supplied as required to a particular section of the building.

The college also possesses a storage battery plant of 24 cells, but owing to the great expense attached to its operation it is not in use.

The building is perfectly ventilated by two 6 H. P. motors, coupled direct to fans, which get a supply of fresh air from a height of over 100 ft., through a chimney or chute, and send it through conduits to all parts of the college.

The laundry is operated by a 7½ H.P. motor doing the duty required, and is supplied with an independent heater for heating water.

The gongs in the building are operated by six cells of storage battery, as also the door bells and annunciators.

The heating is under electric control, the building being equipped with the Johnson Electric Service Company's apparatus, which, as the temperature varies, regulates the valves on the radiators.

The college owns its own pumping plant and gets its supply from the city, but owing to the great height, the water has to be taken from the city main by pumps at the college, and forced 125 ft. to tanks located in the attic, which supply the different parts of the building. There are also return and feed pumps for the boilers. The boilers are three in number—two low and one high pressure. There are hot water boilers and heaters to perform their respective duties.

Two large cisterns holding 30,000 gals. of water are erected on the grounds, so that in case of fire, if the city water supply could not be had, an ample private supply would be available.

It would well repay any reader of this journal to take a trip to Deer Park and inspect the above plant. Mr. Saxby, who has been connected with the college since its erection, in the management of its plant, will give them a warm welcome and show them through the building.

CANADIAN ELECTRICAL ASSOCIATION.

A SUFFICIENT number of Western members of the Association have already intimated to the secretary their intention to be present, to warrant the belief that in point of attendance as well as in all other essential particulars, the approaching annual convention to be held in Montreal in September will prove highly enjoyable, profitable, and in every respect successful. The papers that will be brought before the convention and the discussions thereon will be of the utmost interest to all branches of the profession. They comprise :

Paper on "The Possibility of Securing Better Regulation at Central Light and Power Stations by means of Fly Wheel Accumulators of Improved Construction," by Mr. John Galt, C.E. and M.E., Toronto.

Paper on "A Method of Distribution with Equalization of Potential Difference," by Mr. D H. Keeley, of the Government Telegraph Service, Ottawa.

Paper by Mr. E. C. Breithaupt, Berlin, Ont.

Paper on "The Application of Electricity for Medical and Kindred Purposes, from Light and Power Circuits," by W. B. Shaw, Montreal.

Paper by Mr. T. R. Rosebrugh, Lecturer in Electricity, School of Practical Science, Toronto.

Paper on "Electrolysis," by Mr. J. A. Baylis, Bell Telephone Co., Toronto.

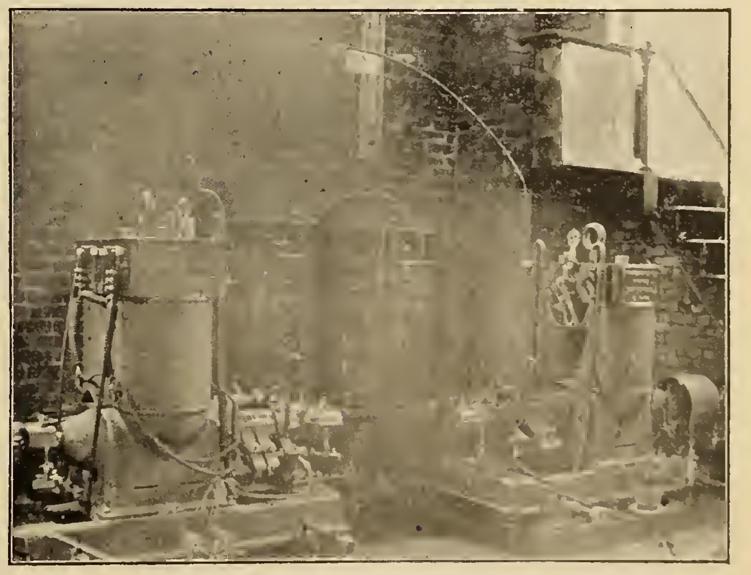
Paper on "Telephone Cables, their Construction and Maintenance," by Mr. F. J. F. Schwartz, Bell Telephone Company, Montreal.

Paper on "Alternating Motors," by L. M. Pinolet. Montreal.

Paper by Mr. John Langton.

Prof. C. A. Carus-Wilson, of McGill University, has invited the Association to inspect the electrical laboratories at that institution, and to witness the operation of apparatus which has recently been completed for the measurement of alternating current power. Prof. Wilson proposes to exhibit the apparatus in conducting an actual test of a transformer.

To enable the committee to make arrangements as complete as possible, it will be necessary for them to know the probable number of members who will attend the convention. Every member is therefore desired to intimate to the secretary, at his earliest convenience, if he is likely to be present, so that the approximate number may be known and accommodation provided, and that advance copies of the papers to be brought before the convention may be forwarded.



VIEW OF DYNAMO ROOM, UPPER CANADA COLLEGE, TORONTO.

As above stated a considerable number of replies, promising attendance, have already been received. It is hoped that those members who have not as yet intimated their intention to be present at the meeting will do so as soon as possible. It is expected that the executive will shortly be in a position to announce definitely the date and details of the programme of the convention.

STREET LIGHTING BY ALTERNATING ARCS.*

By Charles G. Armstrong.

THERE are many places, even in districts for which incandescent lighting meets the general need, were a few arc lamps can be used to good advantage, so it was to be expected that alternating plants would find some calls for arc lamps to be used on their circuits. But there has been such an amount of work done in developing alternating arc lamps—no less than fourteen having appeared on the market since last June—that there must be a larger field for these lamps than that of mere incidental adjuncts to an incandescent plant. So far, these lamps have only been used in small numbers here and there when no series arc circuits were at hand, and the common impression seems to be that there is their limit of usefulness. But I cannot agree with this. I believe that with all its faults and drawbacks the alternating arc lamp has some very good points of merit, and that when these are coupled with the advantages of alternating current distribution for long distances, the alternating arc will lend itself to the conditions of modern practice about as readily as the commonly used series arc lamp. Indeed, I believe it perfectly feasible to use alternating arcs for extended street lighting with as good results as would be expected from a series arc plant under the same local conditions.

At first thought, the planning of a street lighting system for a city, and of using multiple instead of series wiring may seem expensive; but let us look at both sides. If we plot the ideal town plant we find the lamps all arranged along a circle or loop about as shown in Fig. 1, and no doubt the series arc system with a single wire is then the simplest and cheapest. But in practice we find that the towns are not often laid out to suit such simple wiring plans, while Councilmen Smith and Jones and Brown all have their notions as to the location of the lamps, so the actual diagram is more like Fig. 2, much of the wiring being in loops so as to nearly double the length of the circuit. Of course every foot of this wire has to carry the full current (say ten amperes), whereas in multiple system, like that shown by Fig. 3, the size of the wire would diminish as we get farther from the station, both systems using the same voltage, 2,000. This difference in the cost of the wire may amount to considerable. In the case of a 60-light town plant, for which I recently made the estimates, the alternating current transformer system showed a saving of ten per cent. on the wire over that which would have been needed for the same lamps on the ordinary series circuit.

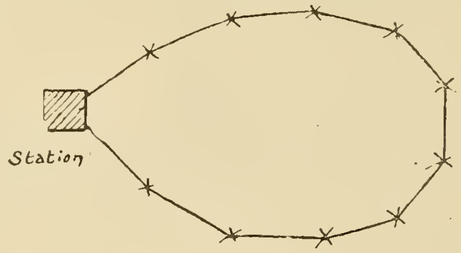


Fig. 1.—Street Lighting by Alternating Arcs.

As to the arc lamps themselves, there has been quite a change during the past year in the voltage adopted for them. The early forms were adapted to be run from 50 volt transformers with a resistance in series. Then this resistance was gradually reduced so as to run three lamps in series on a 100 volt circuit, thus giving better results and taking less energy. Lately the manufacturers have gone a step farther by planning their lamps to work direct from 30 volt transformers, leaving out all resistance. The lamps themselves are as economical as the series lamps, each consuming about 450 watts for a nominal 2,000 candle power. Of course there is the extra cost of the transformer, but this, together with the alternating arc lamp itself, costs no more to-day than a first-class series lamp. The loss in the transformer does not count for much, as the transformer is always worked at full load and therefore at its greatest efficiency. What is more, the transformer tends to steady the fluctuations in voltage at the lamp, so that this cannot creep up to 20 or 57 volts as it often does with series lamps. One of the advantages gained by running arc lamps in multiple is that every lamp is independent of the rest. If a lamp should get out of order, it will keep its crankiness to itself without affecting all of the others. Indeed, the most that it could do would be to short-circuit itself and blow the fuse of the transformer. The same advantage is found in case of a break on the line, as this only cuts out the lamps beyond the break, instead of crippling the whole system. Likewise, only the joints between the given lamp and the dynamo interpose their effective resistance, while in series systems any and all bad joints affect the whole number of lamps. The voltage used at the lamps is harmless; they can be trimmed with safety at any time, and it is comparatively easy to plan the feeders for safety. As to the illuminating power of the lamps, the direct current arcs have the advantage of throwing out most of the light-giving rays in a downward cone, whereas the alternating arc sends out a double cone of light. By using a reflector much of the upwardly projected light can be thrown downward, and in the case of street lighting a portion of the rays will be reflected from the under surface of the foliage. So I think that for the low suspension commonly used throughout the country, the alternating arc is the proper one, while for tower lighting the direct current arc would be preferable.

In comparing the energy of the two systems, the commercial efficiency of the dynamos and the cost of armature repairs will also be an important item. Good series generators show an efficiency of from 80 per cent. to 85 per cent. when built, but after a few years this falls to 70 per cent. and often as low as 50 per cent. On the other hand we can count on from 85 per cent. to 90 per cent. or even 92 per cent. when using alternators and can figure on quite a saving for armature repairs. I have seen figures from 300 arc light stations which average $3 per year per arc lamp for armature repairs alone. This agrees with the commonly known fact that arc armatures are much more likely to be damaged than those of an alternator. I believe that under similar conditions an alternating armature will outlast from two to three arc armatures.

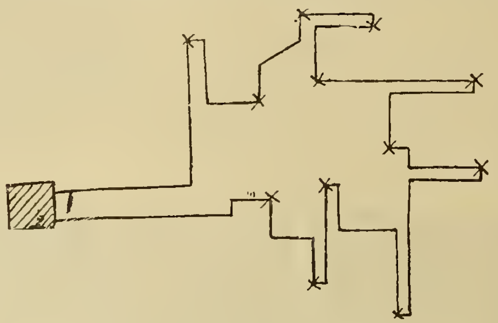


Fig. 2.—Street Lighting by Alternating Arcs.

The matter of carbons for alternating arcs has been an important question, as a fine grade is needed for this work. The lamp manufacturers have wisely taken the expedient of using an inclosing globe, so as to make a carbon last 18 hours which otherwise would be cansumed in 14 hours. Moreover, the carbon manufacturers in this country are hastening to bring out a grade of carbons suited for alternating current work, and the probability is that we can soon purchase American carbons for these lamps at prices not much in advance of that charged for hard series arc carbons.

I have already spoken of the greater efficiency which we can readily expect from the alternating generators. We can also get them in larger sizes, so that in place of from 12 to 20 series machines, each with a capacity of eighty to one hundred lights, we would have, say, three generators of 300 to 400 horse-power each, these being preferably slow-speed machines, connected direct to the engines, thus doing away with belts, ropes and shafting.

At present the common voltage for the primary circuits is about 2,000, having grown to this point from 500, at which it started, and I believe we can assume from 2,000 to 2,500 volts as our settled standard. Still, if I were to plan an ideal arc lighting plant for a large city, I would choose a still higher voltage, perhaps 4,000 volts. My station would be some three or four miles out of town, and I would run my wires in conduits to some distributing centers in the city, transforming at these points to 2,000 volts, and running thence to the alternating arcs.

Figure out such a plant for a good sized town, and note the saving in circuits alone as compared with series circuits which have only from 50 to 100 lights each. You will then see what the prospects are for the extensive use of alternating currents in connection with street lighting by arc lamps.

HIGH SPEED ENGINES.

WE are very apt to think only of our own particular branch of engineering, says the Tradesman, when discussing any problem pertaining to it and this seems particularly so in the case of the high speed stationary engine. In stationary practice we see in first class engine rooms the high speed engines guarded with particular care and the room as free from dust and dirt as it can be made, so as to give all the bearings as little grit or foreign matter as possible. And on a 12 x 18in. high speed engine for sample, running perhaps 300 revolutions per minute, we think it wonderful that it runs and keeps cool, think the piston speed enormous, and hardly dare breathe while near it for fear of a hot box. Yet in locomotive practice we have speeds exceeding this in many instances, and have the engine without any foundation, so to speak, the main boxes never in line (going up and down over the frogs and crossings) and Jersey sand blowing around the engine until the running parts are almost white as snow, yet the engine runs, and gives comparatively little trouble. So that it seems foolish to brag so much about our high speed stationaries, when if run under the same conditions as the locomotives, they would be apt to give unending trouble.

On the other hand, it is very probable that if a locomotive was pinned down to a foundation it would do little better, as the freedom of motion to all its parts must be in a measure responsible for their running at all, the swinging and shaking absorbing jars which might be noticed materially if on a solid foundation.

---

* Read before the Chicago Electrical Association.

CHARACTER SKETCH.

ROSS MACKENZIE

MANAGER NIAGARA FALLS PARK AND RIVER RAILWAY.

> " If you choose to play, is my principle
> Let a man contend to the uttermost
> For his life's set prize, be what it will."

THE wonderful strides that have been made in the application of electricity to present-day methods of travel needs no extended demonstration in these columns. On a sea voyage, Mr. Edison, after spending hours on deck looking at the waves, said, that it made him wild when he saw so much force going to waste. "But one of these days", he continued, "we will chain all that —the Falls of Niagara as well as the winds—and that will be the millennium of electricity". The millennium of Mr. Edison has not yet come, but who will say when it may not be expected?

The development of electric transmission has found one of its chief products in the electric railway. There are in operation over 250 electric railways in the United States, embracing 2024 miles of track and utilizing 3830 motor cars, operated by 6400 motors, with an estimated capacity of 174,435 horse-power. Out of 956 street car plants existing in the United States and Canada, 589 are operated by horses, 49 by cables, 240 by electricity and 73 by steam. "Canada has been", says the Electrical Engineer, "quicker than any other part of the British Empire, excepting the Mother Country, to appreciate and adopt the electric railway". These pioneer roads are found in the familiar Metropolitan line, running out from North Toronto; at Windsor and at St. Catharines. Perhaps the most important step, however, in the direction of applying electricity to railway transmission is found in the construction of the now popular Niagara Falls Park and River Railway, running from Queenston to Chippawa, giving a view of Niagara Falls, that enhances in a wonderful degree the marvellous beauty of that picturesque spot. A description, and illustrations, of this road have already appeared in these columns, and there is no need of a further sketch here. Let us, however, turn our attention to the man, who, by his ability and energy, is doing much to popularize and make successful this electric railway.

MR. ROSS MACKENZIE.

The manager is Mr. Ross Mackenzie, who claims as his birthplace New York city, first seeing the light there in 1857. The greater part of his lifetime, however, has been spent in Canada. He received his education at the Model School and Upper Canada College, Toronto.

Waterloo was won on the play grounds at Eton, said the Duke of Wellington, because the spirit that made the boys at Eton struggle to be best in a game, and discipline themselves in cool nerve and courage to win a school match, was the same spirit that made them study on the great day when the game was fought with armies and the prize was the liberty of Europe. Ross Mackenzie is remembered by many Torontonians for his love of outdoor sports. Old lacrosse players know him as one of the "boys", who always helped them to reach goal successfully. Taking his later success in life as evidence, it is not unfitting to apply the reference of the Duke of Wellington to Mr. Mackenzie's career.

In 1873 Ross Mackenzie entered the service of the Shedden Company, and in 1875 became the agent of that company in Hamilton. In 1876 and 1877 he was in the employ of the same Company in Toronto. In 1878 the position of book-keeper for the Credit Valley Railway, then under construction, was offered Mr. Mackenzie and he accepted it. In 1880 he was appointed cashier and accountant of the railway, and in 1884 when the Credit Valley was merged in the Canadian Pacific Railway he received another "move up," becoming general superintendent's accountant of the Ontario division. A year later he was removed to Montreal to the eastern division.

Those whose pleasure it has been to meet Mr. Mackenzie, have always found him genial, and indeed jovial. To apply a remark made of Walter Raleigh, "He was one who seemingly achieved great things with a certain airy ease and instinctive facility of touch". Yet it was of Raleigh, Queen Elizabeth said, "he could toil terribly". Mr. Mackenzie has always been a worker whether on the play ground or in a railway office, and the steady advances he has made indicates the importance of the thoroughly trained man in any calling.

It may be a question in the present day of many schools and much studying whether there is need for more education, but this is becoming clearer every day that there is a growing need for more education on distinctive lines. As the Outlook has recently said: "In the long run it is the trained man who succeeds, because it is the trained man who studies all the conditions of success and meets them intelligently. Twenty years ago our railroads were run on free and easy principles, with a happy-go-lucky assurance that good natured and industrious men could get the trains through. Now the best of the railroads are run on scientific principles, with experts in every department, and the whole management as thoroughly organized as if it were a great scientific institution; and the success of the roads in the matter of dividends and freedom from accidents depends very largely upon the thoroughness of the organization and the scientific spirit in which it is conducted."

When the Niagara Falls Park and River Railway was in running shape, Mr. W. A. Grant became manager. Later Mr. Mackenzie was removed from Montreal and succeeded Mr. Grant. The road has been a success beyond the best expectations of its promoters. Though a year of commercial depression, Mr. Mackenzie intimates that the traffic this year, so far, has been much in excess of a year ago. So assured indeed has been the success that the company felt warranted in double-tracking the road this year, a step that is certainly appreciated by the travelling public and has proven a needed and wise move by the railway. It is fair to say that this success has been attained, in a large measure, because the railway is manned by such trained and thorough-going business men as Mr. E. B. Osler, of Toronto, the president; Mr. W. Hendrie, of Hamilton, vice-president; and Mr. Ross Mackenzie, manager.

ENGINE AND BOILER FOUNDATIONS.

THE depth of engine foundations should be at least six feet, says a contributor to the Boston Journal of Commerce, unless there is a good rock bottom before reaching this depth, so that the engine anchor bolts may be anchored directly into the rock; otherwise, if there is no such rock to anchor to, and the above depth has not been made, there will not be enough weight to the foundation to hold the engine down. The writer is well aware of the fact that there are engines on the market today where great care and attention has been given thoroughly to counter-balance the engine, so that the engine will run steadily and smoothly, set upon four pins, and will not jar or shake off the pins, the engine not being bolted to the foundation. The above is all right so far as it goes, but will not answer for large engines, and especially when the engine is very heavily loaded. The length of the foundation on the shaft end of the bed, measured from the centre of the shaft to the end of the foundation, should be equal to the length of the foundation measured from the cylinder end of the bed to the centre of the shaft. The correct proportion of this foundation is about seven and one-half times the stroke of the engine. In a great many places this length of foundation on the shaft end of bed has been very much diminished. There is no better place to throw in a brick on an engine foundation than on the shaft end; here is where the weight is required.

The above dimensions which have been given will make the ends of the foundation equally divided on each side of the centre of the shaft in the centre of the apex of the foundation. The width of the foundation at the bottom should be equal to eight strokes of the engine. In the case of an engine 12-inch stroke this would be 96 inches.

Concerning the boiler foundations, T. F. Scheffler tells the American Society of Mechanical Engineers that his experience has found a depth of 3 feet below the floor line to be sufficient. A good, hard sandstone will give good results when brick is not used, which some people prefer. The width of the foundation should be 6 inches more on the floor line than the boiler side walls, which should be 24 inches for a boiler above 5 feet diameter. There has been considerable argument about the best height from the floor line to the fire-door opening; 22 to 24 inches is a satisfactory height, but 30 inches is considered a much more satisfactory and better height for the ordinary fireman, and in many instances where the fronts themselves do not permit of this height it has been obtained by raising them 6 inches or more above the floor line, and has been given good satisfaction. Another point that is debatable is the height from the bridge wall to the boiler. For 66-inch boiler 12 inches is a good height, as this gives an area between the bridge and shell largely in excess of the boiler-tube area. Another point of consideration is the distance of the grate from boiler, which this writer gives as 26 inches for a 66-inch boiler burning soft coal, and this height he finds has proven very satisfactory. Such a height will evaporate more water than 30 inches.

GOVERNMENT INSPECTION OF ELECTRIC LIGHT.

FOLLOWING are the provisions of the Act passed at the last session of the Dominion Parliament for inspection and regulation of electric lighting plant :—

1. This act may be cited as *The Electric Light Inspection Act.*

2. In this Act, unless the context otherwise requires,—

(*a.*) The expression "contractors" means any company or person undertaking to furnish electricity to any purchaser for lighting purposes.

(*b.*) The expression "purchaser" means any person to whom electricity is furnished for lighting purposes.

(*c.*) The expression "meter" means electric light meter, and includes every kind of machine, apparatus or instrument used for measuring the quantity of electrical energy furnished to the purchaser.

(*d.*) The expression "purchaser's terminals" means the ends of the electric lines or conductors situate upon the purchaser's premises at which the supply of electricity is delivered from the service lines.

(*e.*) The expression "department" means the Department of Inland Revenue.

(*f.*) The expression "Controller" means the Controller of Inland Revenue.

3. The commercial unit of supply of electrical energy shall be one thousand watt-hours, or the equivalent thereof in ampere-hours.

4. Before commencing to give a supply of electrical energy for illuminating purposes to any purchaser, the contractors shall declare to such purchaser the constant pressure at which they propose to supply energy at his terminals.

2. The variation of pressure at any purchaser's terminals shall not under any conditions of the supply which the purchaser is entitled to receive, nor at any time, exceed three per cent. from the declared constant pressure, whether such variation is due to the resistance of the service lines or apparatus belonging to the contractors, or to any action or effect produced by such apparatus, for which the purchaser cannot be shown to be responsible, or partly to a variation of pressure in the distributing mains from which the supply is taken.

3. The contractors shall not be liable for any variation of pressure caused by unavoidable accident to the generating plant or apparatus, or by the uncontrollable condition of the elements.

5. The contractors shall be responsible for all electric lines, fittings and apparatus, belonging to them or under their control upon the purchaser's premises, being maintained in a safe condition and in all respects fit for supplying energy ; but they shall not be responsible for any damages arising from the use of electric current in lines, fittings and approaches not belonging to them or under their control.

6. If the contractors are reasonably satisfied, after making all proper examination by testing or otherwise, that at some part of a circuit a connection with the earth exists of such resistance as to be a source of danger, and that such connection does not exist at any part of the circuit belonging to the contractors, any officer of the contractors duly authorized by them in writing, may, for the purpose of discovering whether such connection with the earth exists at any part of the wires upon any purchaser's premises, at all reasonable times, after giving one hour's notice of his intention to do so, enter such premises and disconnect the purchaser's wires from the service lines, and may require the purchaser to permit him to inspect and test the wires and fittings belonging to the purchaser and forming part of the circuit.

7. If on such testing the officer discovers that a connection exists between the purchaser's wires and the earth, and that such connection has an electrical resistance not exceeding five thousand ohms, or if the purchaser does not give all due facilities for such inspection and testing, the contractors shall forthwith discontinue the supply of energy to his premises, giving immediate notice of such discontinuance to the purchaser, and shall not recommence such supply until they are satisfied that such connection with the earth has been removed.

8. If any purchaser is dissatisfied with the action of the contractors, either as to the mode of making the test or in discontinuing the supply of electricity to his premises, the wires and fittings of such purchaser may, on his application to the department, be tested for the existence of such connection with the earth by an electric light inspector.

9. If the contractors make default in complying with the requirements of any of the foregoing sections as to supply; they shall be liable for every such default to a penalty not exceeding twenty dollars for every day during which such default continues.

10. Any person who maliciously or fraudulently abstracts, causes to be wasted or diverted, consumes or uses any electricity, shall be deemed guilty of theft and punishable accordingly.

11. Any officer appointed by the contractors may, at all reasonable times, enter any premises to which electricity is or has been supplied by the contractors, in order to inspect their electric wires, meters, accumulators, fittings, works and apparatus for the supply of electricity, or for the purpose of ascertaining the quantity of electricity consumed or supplied, or, where a supply of electricity is no longer required or the contractors are authorized to take away and cut off the supply of electricity from any premises, for the purpose of removing any electric lines, accumulators, fittings, works and apparatus belonging to the contractors, repairing all damage caused by such entry, inspection or removal.

12. Inspectors of weights and measures, or of gas, or other officers of inland revenue, may be appointed and may act as electric light inspectors under this Act ; but no such inspector shall be a seller of electricity or electric meters, or be employed by any person or company supplying electricity or meters ; and no electric inspector shall repair or adjust any meter inspected or verified by him.

13. The amount of electrical energy supplied by contractors to any purchaser under this Act for lighting purposes, or the electrical quantity contained in such supply, shall, if the purchaser so desires, be ascertained by means of a suitable meter, duly certified in accordance with regulations established under the authority of this Act.

2. Whenever a reading of a meter is taken by the contractors for the purpose of establishing a charge upon the purchaser, the contractors shall cause a duplicate of such reading to be left with the purchaser.

14. No electric-light meter shall be fixed for use which has not been verified and stamped as hereinafter provided.

15. No meter shall be fixed for use unless it plainly indicates by means of suitable dials the amount of current or energy passing to the purchaser's wires.

2. Electrolytic meters at present in use may be continued ; but the number of such meters shall not be added to, and all renewals of meters shall be made by the substitution of the direct-reading types.

3. The capacity of every meter fixed for use shall be marked in a conspicuous place with the number of amperes or watts it is constructed to supply.

16. No meter shall be stamped which is found by the inspector to register, or to be capable of being made to register, quantities varying from the legal standard unit of electricity more than three per cent. in favor of either the contractor or the purchaser.

17. The verification of each meter shall be attested by affixing or impressing on some essential part thereof, a stamp or mark of such description and in such a manner as is directed by regulations made by the Controller.

18. Within twelve months after the expiration of five years from such verification and stamping, every meter shall again be verified and stamped.

19. No meter duly stamped as aforesaid shall be liable to be re-verified or re-stamped within a period of five years from the then last verification or re-verification thereof, although it is used in any other place than that at which it was originally stamped, but shall be considered a lawful meter throughout Canada, unless found incorrect under this Act, or requiring re-verification by lapse of time as aforesaid.

20, In every case the contractor shall keep the meter in good repair, and shall be responsible for the due inspection thereof, and, except as herein otherwise provided, shall pay the fee lawfully chargeable for such inspection, and shall be liable for all penalties incurred with respect to such meter.

21. The verification and testing of meters shall be performed in accordance with the provisions of this Act and with such further regulations, not inconsistent therewith, as are made by the Controller.

22. The contractors shall provide electricity and wiring and all other reasonable facilities for testing, free of charge, at such places as are agreed upon between the contractors and the department.

23. If any dispute arises between the contractor and the purchaser or between the contractor and the inspector, respecting the correctness of such meter, the inspector shall, if required by any person dissatisfied, refer such dispute to the department for final decision.

24. The inspector shall give to either the contractor or the purchaser, or to both, on payment of the proper fee, a certificate stating the result of his inspection, and the time at which it was made, and at whose instance, and any other particulars he thinks it right to insert for the information and guidance of the persons concerned ; and such certificate shall be *prima facie* evidence of the condition of the meter inspected, and shall bear an adhesive stamp or stamps representing the fee lawfully chargeable for such certificate.

25. The contractors shall at all times keep in their office, in a book or books, the names and addresses of purchasers for the time being—which book or books shall be open to the inspector during office hours, and from which he may take such extracts as he thinks fit ; and for any failure to comply with the requirements of this section, the contractors shall incur a penalty of fifty dollars.

26. The fees for inspection of purchasers' wires and the testing of lamps and meters shall be determined from time to time by the Governor in Council and published in the Canada Gazette, and such fees shall be regulated so that they will, as nearly as may be, meet the cost of carrying this Act into effect ; and all fees received under this Act shall be accounted for and paid to the Minister of Finance and Receiver General at such time and such manner as the Controller directs, and shall form part of the Consolidated Revenue Fund of Canada.

27. The Governor in Council may from time to time direct stamps to be prepared for the purposes of this Act, bearing such device as he thinks proper, and may defray the cost thereof out of any unappropriated money forming part of the Consolidated Revenue Fund of Canada ; and the device on such stamps shall express the value thereof, that is to say, the sum at which they shall be reckoned in payment of the fee hereby prescribed.

28. Separate accounts shall be kept of all expenditures incurred and of all fees and duties collected and received under the authority of this Act ; and a correct statement thereof up to the thirtieth day of June then last past, shall be yearly laid before Parliament within the first fifteen days of the then next session thereof.

29. Every person who, except under authority of this Act, makes, causes or procures to be made, or knowingly acts or assists in making, or who forges or counterfeits, or causes or procures to be forged or counterfeited, or knowingly acts or assists in the forging or counterfeiting any stamp or mark used for the stamping or marking of any meter under this Act, shall incur a penalty not exceeding two hundred dollars and not less than fifty dollars ; and every person who knowingly sells, utters or disposes of, lets, lends or exposes for sale, any meter with such forged stamp or mark thereon, shall, for every such offence, incur a penalty not exceeding two hundred dollars and not less than twenty dollars ; and all meters having on them such forged or counterfeited stamps or marks shall be forfeited and destroyed.

30. Every person who knowingly repairs or alters, or causes to be repaired or altered, or knowingly tampers with or does any other act in relation to any stamped meter, so as to cause such meter to register wrongly, or who prevents, or refuses lawful access to any meter in his possession or control, or obstructs or hinders any examination or testing authorized by this Act, shall incur a penalty not exceeding one hundred dollars and not less than fifty dollars, and shall pay the fees for removing and testing, and the expense of purchasing and fixing a new meter : Provided that the payment of any such penalty as aforesaid shall not exempt the person paying it from liability to indictment or other proceeding to which he would otherwise be liable, or deprive any other person of the right to recover damages against such person for any loss or injury sustained by such act or default.

31. Every person who fixes for use, or causes to be fixed for use, any meter, before it has been verified and stamped as herein required, shall incur a penalty of twenty-five dollars for every such unverified or unstamped meter.

32. Every inspector who stamps any meter without duly testing and finding it correct, or who refuses or neglects, without lawful excuse, for three days after being required under the provisions of this Act, to test any meter, or to stamp any meter found correct on being so tested, or who neglects to perform any duty imposed upon him by this Act, or by any regulations made under the authority thereof, shall incur a penalty not exceeding fifty dollars and not less than ten dollars, and shall be liable to dismissal from office.

33. All penalties imposed by this Act, or by any regulation made under the authority thereof, shall be recoverable in a summary manner, with costs, before any justice of the peace for the district, county or place in which the offence was committed, if the penalty does not exceed twenty dollars, and before any two justices of the peace if the penalty exceeds twenty dollars, and may, if not forthwith paid, be levied by distress and sale of the goods and chattels of the offender, by warrant under the hand and seal of the Justices by whom also any imprisonment to which the offender is liable may be awarded.

34. No action or prosecution shall be brought against any person for any fine or penalty under this Act, unless it is commenced within six months after the offence is committed.

35. Before supplying electricity to purchasers, the contractors shall obtain

from the department, or from an officer appointed for the purpose, a certificate of registration and shall pay the officer issuing such certificate the fees prescribed by the Governor in Council.

2. Such certificate shall expire on the day of in each year, and shall be renewable from year to year.

36. So soon as the standards and apparatus have been obtained and approved, the Governor in Council may issue a proclamation, fixing a day, not less than six months from the date of such proclamation, upon which the provisions of this Act respecting inspection shall go into operation.

37. The Governor in Council may establish rules and regulations—

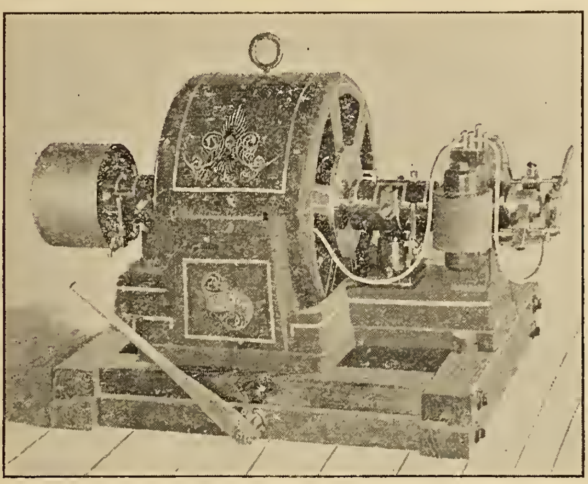
(*a.*) For the testing of electric light lamps for illuminating power ;

(*b.*) For instituting tests to determine what style or make of meter shall be used to measure the quantity of electrical energy supplied ; and

(*c.*) Such other regulations, not inconsistent with this Act, as are necessary for giving effect to its provisions, and for declaring its true intent and meaning in all cases of doubt.

NEW ALTERNATING AND DIRECT CURRENT DYNAMO.

THE new alternator represented by the accompanying illustration has no commutator, brushes, or moving wire. It is of the inductor type, but so constructed, the makers claim, that the troubles common to this class are eliminated. The revolving field is a smooth surface, having plenty of cooling surface. Surrounding this are three stationary coils, wound ring shape, and laid in their places. Both field and armatures are thoroughly laminated, and the magnetism does not reverse in any part, but merely rises and falls ; while the magnetic flow through the field coil never varies, consequently there is no inductive effect on the coil. To effect this, when the field is distorted a short circuited coil of low resistance is placed inside the field coil. The space occupied by the generating coil is not of so much importance as in wire wound armatures, making it possible to use larger inductors and a heavier insulation, and as there is no mechanical strain on this wire, a burn-out is practically impossible.



ALTERNATING AND DIRECT CURRENT DYNAMO.

The speed of this machine is said to be slower than any other of its output on the market. The boxes are large, self-oiling, self-lining and adjustable, and are provided with oil-gauges.

The exciter is direct-driven, and the armature so made that it may be easily moved from main shaft. An automatic regulator is provided, which keeps the lights perfectly steady through any variation of load, and it is claimed that owing to the simplicity of the apparatus it requires very little attention.

These machines are manufactured by Messrs. F. H. Sleeper & Co., Coaticook, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of the various Associations are requested to forward to us matter for publication in this Department not later than the 20th of each month.

TORONTO ASSOCIATION NO. 1.

TORONTO, JULY 29th, 1894.

Toronto No. 1 has held two successful meetings during the present month, there being two proposals for membership and four candidates initiated. Interesting discussions have taken place on safety valves and indicator diagrams. The fourth annual convention will be held in Toronto Sept. 4th to 7th inclusive. A large attendance is expected.

W. G. BLACKGROVE,
Cor.-Secretary.

THE ANNUAL CONVENTION.

Following is an outline of the programme which has been arranged for the annual convention to be held in Toronto from the 4th to the 7th of September :—

Tuesday, Sept. 4th.—Convention opens at 10 a.m.; afternoon session ; evening, open meeting.

Wednesday, Sept. 5th—Forenoon session ; afternoon, drive around city, terminating at Exhibition grounds; evening, banquet.

Thursday, Sept. 6th—Trip to Niagara Falls, American Power House and Hydraulic Canal.

Friday, Sept. 7th—a.m. and p.m., session ; election of officers.

Papers on interesting subjects will be read at the open meeting and sessions. All engineers are invited to attend the open meeting on Tuesday evening, Sept. 4th. A. M. Wickens, Chairman Committee ; H. Terry, Secretary ; G. Fowler, Treasurer ; W. G. Blackgrove, Cor.-Secretary.

HAMILTON ASSOCIATION NO. 2.

HAMILTON, July 25th, 1894.

Editor ELECTRICAL NEWS.

SIR,—I am glad to report that Hamilton No. 2 is getting along very nicely. Our meetings of late have not been marked by many engineering discussions owing to the very warm weather, but by the way things looked at our last meeting we will soon have a good report to make every month. We find that the manufacturers are very much interested in our behalf, and that our conventions and annual suppers are looked forward to with considerable pleasure.

W. NORRIS,
Cor.-Secretary.

BRANTFORD ASSOCIATION NO. 4.

BRANTFORD, July, 1894.

The following officers were installed by Bro. A. Ames at our last regular meeting :—C. Walker, President ; J. B. Forsyth, Vice-President : Jos. Ogle, Secretary ; L. Fordham, Treasurer ; T. Pilgrim, Conductor ; A. McKinnon, Doorkeeper.

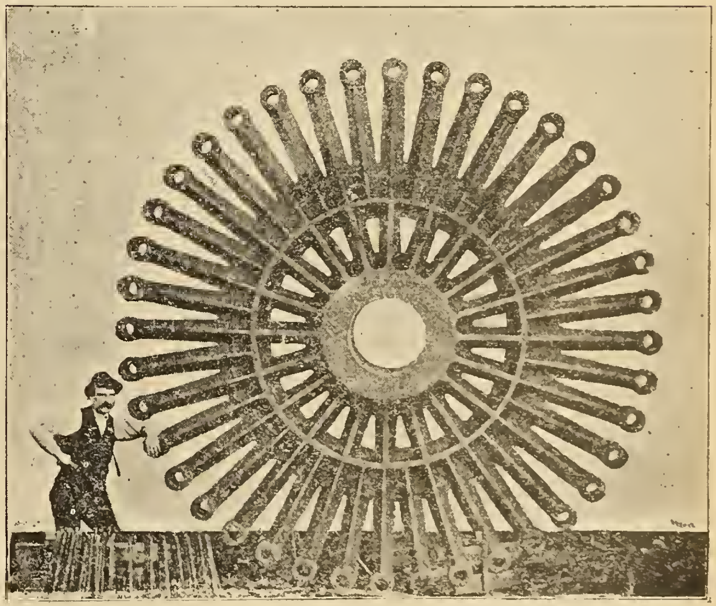
I might say that No. 5 is slowly growing in numbers and is in a very good condition, the meetings being well attended and all the members except one holding responsible positions and certificates of competency. After the installation our time was devoted to black board exercise.

JOS. OGLE, Secretary.

The coroner's jury appointed to inquire into the recent boiler explosion at the Michigan Central Railway depot at Cayuga, Ont., which resulted in the killing of John Comer, brought in the following significant verdict : "That the deceased John Comer came to his death by accident. We attach no blame to anyone, and the jury recommend that engineers professing to run boilers should stand some examination to show that they are qualified and competent for that business. We also recommend that all boilers should be officially examined every twelve months."

THE LARGEST ARMATURE STAR.

IN the accompanying illustration is shown one of a pair of armature stars, believed to be the largest in the world, and which are to be installed in the power station of the Toronto Railway Co. The machines when completed will weigh about 60 tons each and have a nominal capacity of 1200 kilowatts, or 1600 electrical horse-power each, under 500 volts pressure, and will be over compounded for 12 per cent drop in the lines. They are to be directly connected to a pair of horizontal cross compound condensing engines making 80 revolutions per minute. The armature stars are 13 feet in diameter and weigh over 10 tons each. The brush carriers will be about 14 feet 6 inches in diameter.



The Compagnie des Pouvoirs Hydrauliques de St. Hyacinthe, Que., has given a contract to the Canadian General Electric Co., through Mr. W. F. Dean, agent for Quebec, for two 175 K. W. three phase generators. These generators which are to be operated by water power are to transmit current at 2,500 volts for light and power to St. Hyacinthe, a distance of five miles. This plant, which is the first of the polyphase system in Canada, is to be in operation by about the 1st October.

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ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 25th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 22nd day of the month.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription may be remitted by currency, in registered letter, or by postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters must be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union, $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. *When ordering change, always give the old as well as the new address.*

The Publisher should be notified of the failure of subscribers to receive their papers promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal

THE "CANADIAN ELECTRICAL NEWS" HAS BEEN APPOINTED THE OFFICIAL PAPER OF THE CANADIAN ELECTRICAL ASSOCIATION.

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TORONTO BRANCH NO. 1.—Meets 2nd and 4th Friday each month in Room D, Shaftesbury Hall. Wilson Phillips, President; Geo. H. Blackgrove, Secretary, 43 Brant street.

HAMILTON BRANCH NO. 2.—Meets 1st and 3rd Friday each month, in Maccabee's Hall. Jos. Langdon, President; Wm. Norris, Corresponding Secretary, 211 Wellington Street North.

STRATFORD BRANCH NO. 3.—John Hoy, President; Samuel H. Weir, Secretary.

BRANTFORD BRANCH NO. 4.—Meets 2nd and 4th Friday each month. C. Walker, President; Joseph Ogle, Secretary, Brantford Cordage Co.

LONDON BRANCH NO. 5.—Meets in Sherwood Hall first Thursday and last Friday in each month. F. Mitchell, President; William Meaden, Secretary Treasurer, 533 Richmond Street.

MONTREAL BRANCH NO. 1.—Meets 1st and 3rd Thursday each month, in Engineers' Hall, Craig street. President, Jos. Robertson; first vice-president, H. Nuttall; second vice-president, Jos. Badger; secretary, J. J. York, Board of Trade Building; treasurer, Thos. Ryan.

ST. LAURENT BRANCH NO. 2.—Meets 1st and 3rd Tuesday each month, in Mechanics' Institute, 204 St. James street. Matthias Guimond, President; Alfred Latour, Secretary, 306 Delisle street, St. Cunegonde.

BRANDON, MAN., BRANCH NO. 1.—Meets 1st and 3rd Friday each month, in City Hall. A. R. Crawford, President; Arthur Fleming, Secretary.

GUELPH BRANCH NO. 6.—Meets 1st and 3rd Wednesday each month at 7:30. p.m. C. Jorden, President; H. T. Flewelling, Secretary, Box No 8.

OTTAWA BRANCH, NO. 7.—Meets 2nd and 4th Tuesday, each month, corner Bank and Sparks streets; Frank Robert, President; F. Merrill, Secretary, 352 Wellington Street.

DRESDEN BRANCH NO. 8.—Meets every 2nd week in each month; Thos. Merrill, Secretary.

BERLIN BRANCH NO. 9.—Meets 2nd and 4th Saturday each month at 8 p. m. W. J. Rhodes, President; G. Steinmetz, Secretary, Berlin Ont.

KINGSTON BRANCH NO. 10.—Meets 1st and 3rd Tuesday in each month in Fraser Hall, King Street, at 8 p.m. J. Devlin, President; A. Strong, Secretary.

WINNIPEG BRANCH NO. 11.—President, Chas. E. Robertson; Recording Secretary, L. Brandon; Financial Secretary, Arthur Harper.

KINCARDINE BRANCH NO 12.—Meets every Tuesday at 8 o'clock, in the Engineer's Hall, Waterworks. President, Jos. Walker; Secretary, A. Scott.

WIARTON BRANCH NO. 13.—President, Wm. Craddock; Rec. Secretary, Ed. Dunham.

PETERBOROUGH BRANCH NO. 14.—Meets 2nd and 4th Wednesday in each month. S. Potter, President; C. Robison, Vice-President; W. Sharp, engineer steam laundry, Charlotte Street, Secretary.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

BOARD OF EXAMINERS.

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Information regarding examinations will be furnished on application to any member of the Board.

ON July 5th fire destroyed the Administration, Mining and Electricity, Machinery and Liberal Arts Buildings at the World's Fair grounds, Chicago. Thus in one short year has passed away the spectacle whose grandeur awakened world-wide admiration.

SOME of the horse cars formerly used on the Toronto street railway are being put to a novel purpose. They have been removed to Victoria Park, the wheels taken off, and the car bodies fitted up with sleeping berths, in which condition it is said they are rented to campers at $1.50 per week. It would be interesting to learn whether the managers of any of the other street railways have hit upon as novel and profitable a method of utilizing their discarded equipment. Locality has considerable to do with the possibilities in this direction.

AN expert who was called on by the Council of an American city to interpret a clause in a contract with a local electric lighting company, is said to have done so after the following fashion: "The arc lights are hung at the street intersections, and each one throws its light in four directions; 2,000 c. p. of lights on each of the four streets, therefore, cannot be expected. An arc light which throws 500 c. p. of light along each of four streets is a 2,000 c. p. light, as called for in the contract." This information is about on a par with some of the estimates of the cost of lighting the streets of Toronto.

THE extreme altitude maintained by the mercury during the past few weeks, whilst not favorable to business in many lines, afforded a golden opportunity for impressing people with the fact that in such weather an electric fan will make life not only bearable, but even comfortable. We may presume that the agents of the electric companies have as usual been alive to the situation, and that the education of the public in this direction has not been allowed to be neglected. Indeed the shop windows bear testimony to the fact that the electric fan is winning recognition, though possibly not as yet to the degree to which its usefulness should entitle it.

ON the 12th of July the street car traffic on the principal thoroughfares of Toronto was blocked for upwards of an hour during the passing of the Orange parade. We have been informed that a conductor who declined to stop his car on the ground that by so doing he would be disobeying orders, was viciously assaulted by one of the marshals of the procession. The street car traffic of a great city should not be allowed to be thrown into confusion by an Orange procession or any other kind of a procession, as thereby thousands of people are likely to be seriously inconvenienced. Street railway companies in cities should force this question to an issue without delay, and find out whether the right of way which they are supposed to have purchased is to be secured to them or not. The rights of the business and travelling community are likewise concerned in the settlement of the question.

A MONTREAL despatch states that at a meeting of Canadian and American capitalists held in that city recently the advisability of organizing a new line of street cars, for the propulsion of which gas instead of electricity would be employed, was considered. It is stated that further information on the subject is to be prepared and submitted for the approval of a committee. An experiment with the use of gas in the manner proposed has lately been conducted on the tramways at Croydon, Eng. The modus operandi is described thus : "The motor is placed under the tramcar together with three cylindrical gas-holders. These three reservoirs hold a sufficient supply of gas to serve for an eight-mile run. The car is about 18ft. long, and, with the machinery, weighs 5½ tons. The motor, which is of the Otto type, and is specially constructed for tramway work, has a slow and quick speed. The ignition of the charge in the motor cylinders is effected by electricity, and the cylinders exhaust into a condenser. At the charging station an 8 H. P. Otto engine drives a compressor. By this latter the gas, which is taken from the mains, is pumped into a steel receiver at a pressure of 150 lb. per square inch. This plant is equal to the supply of five tramcars, the number which it is intended to place on the line at first. The pressure in the tramcar cylinders is about 120lb. per square inch at starting, and the cost of the gas used is stated to be 1d. per mile with a fully loaded car." The results of the experiment have not yet been made known. It is believed to be extremely doubtful whether the efficiency and economy to be realized by this method will equal those already secued by the use of electricity.

DURING a recent visit to Canada Mr. Alexander Siemens gave to the press complete figures of the estimated cost, operating expenses and probable income for the Pacific cable connecting Canada and Australasia, which formed one of the objects of the Intercolonial Conference at Ottawa. The figures given have all the weight of Mr. Siemens' great authority in cable construction and the endorsement of other cable experts, and may be accepted as correct. It is seldom that complete figures on cable work are made public, and apart from the main result shown by the balance sheet, the details, of which the bulk items are composed, reveal many interesting facts. The total length of the cable, about 8,420 statute miles, would average $1000 per mile, of which the deep sea portion would cost $1,500 per mile and cable for shallower water $870 per mile. Two repairing steamers would be required costing $500,000 each. Between New Zealand and Vancouver the cable would be landed at three islands, dividing it into four working sections, and the instruments and buildings for the staff would cost $150,000. The staff and office expenses at these five stations vary from $10,000 per annum at Vancouver to $30,000 per annum at Neckar and Canton Islands, where the employees have to be boarded and lodged, and in addition receive 50% larger salaries, these islands being mere rocks in the ocean, and as Mr. Siemens mildly expresses it, "very undesirable habitations." The chief items of repairs and renewals are 200 miles of cable replaced per annum and the cost of maintaining the two repairing ships. Each vessel costs, $3,500 a month to keep it lying in port ready for business, and an additional $500 per day when it is actually at sea and at work, which it is estimated will be for about two months in the year. On one point no information is given, and that is during what portion of the four months cruising of the repairing steamers cable communication would be actually interrupted, which would mean irretrievable loss of revenue. The cruising time, no doubt, includes carrying supplies to stations, and if a fault develops gradually the cable steamer may be able to reach the spot, grapple and splice without any actual interruption, but with a sudden ground it might require more than a week to reach the spot. We regret Mr. Siemens did not touch on this topic. An interruption would be a public calamity at Neckar and Canton Islands ; not lively at the best of times when work was brisk, with no occupation for the staff but to draw rations and watch the accumulation of unspendable income, they would be—well "very undesirable habitations".

INVESTIGATIONS of the distance to which water power can be transmitted by electricity and profitably sold in competition with steam power have been numerous of late. Also criticisms of these investigations, and counter-criticisms of these criticisms. Where the criticisms have been sufficiently ill judged or the counter criticisms sufficiently acrimonious the matter has been dropped, and it is probable that more than one rash "expert" is sorry he spoke. But when these are eliminated and we turn with relief to those who remain in temperate discussion of this most important question the conclusions we are led to are largely negative. We find that amongst those who have the right to speak with some authority there exists profound differences of opinion as to what it may be fairly said has been shown probably possible by experience. The Lauffen-Frankfort experiment of 1891 is really the only actual experience of transmission for over 25 or 30 miles. This transmission delivered 200 H. P. at a distance of 109 miles from the generator, with a maximum pressure of 30,000 volts between conductors, and was in operation only during the time of the Frankfort exhibition. This base is too small to give confidence in the electrical estimates that have been built upon it. There is no doubt that the 15 mile transmission from Niagara to Buffalo will be successful both electrically and commercially, but we think that the engineering profession will be greatly surprised if, even in this comparatively simple case, with only 20,000 volts, there are not many unlooked for difficulties in getting the plant into successful operation. On its commercial side the agitation has brought into useful prominence how radically the economy is affected by the size of the plant ; not only, as in ordinary enterprises, by the smaller proportion of general expenses when distributed over a large business, and the generally smaller cost per H. P. of developing large water powers, but also by the marked increase in efficiency and decrease in cost per H. P. of large electrical machinery. 98% efficiency is stated for 5000 H. P. generators and 1000 H. P. motors, and prices of $6.50 to $7.00 per H. P. The net results are to show the impossibility of laying down any general rule as to the economical distance of power transmission applicable to all conditions, and to add to the impatience with which the electrical world awaits the completion of the Niagara plant, whose promoters know more about it and say less than any one else, and who have contracted to sell power to barges on the Erie canal at $20 per H. P. per annum.

In the meantime both water power and steam power are threatened with a new rival in the development of the gas engine. By combustion of gas in the engine cylinder the heat energy in the coal is converted into power more efficiently than when it is carried round viâ a steam boiler. But the known thermal economy of gas engines has not been available commercially owing to the cost of making gas. But in the last few years several cheap modes of producing fuel gas have been devised, and thus stimulated, manufacturers have gradually increased their sizes until to-day they are not far from 1000 H. P. and giving 1 H. P. to ¾ lbs. of coal. As this is twice as good as the best performance of triple expansion condensing engines there is a large margin to work on in the cost of producing gas from the coal as compared with the cost of producing high pressure steam. A large gas producing plant at the mines, using not only coal at the pit's mouth, but the slack and shaley waste, could either transmit the gas by pipe lines, or with gas engines on the spot produce power for electrical transmission. Such a power plant would be likely to compete seriously with natural water powers, whilst in gas transmission by pipe lines electric transmission for long distances would find a rival to put it on its metal.

AMONGST those interested in electric street railways there has recently been some preliminary discussion looking to the formation of a Canadian Street Railway Association, whose objects would be similar to the street railway association in the United States. In view of the rapidly increasing magnitude and importance of the electric street railway interests in Canada some association for the discussion of common difficulties and the promotion of common interests is a natural development. Membership in the American Association will meet many of their needs, but in a different country and climate, the Canadian railways operate under many conditions in which the American roads have no share or interest. These conditions, however, are not without interest to other classes of electrical enterprise in Canada, and directly or indirectly are shared by them. The street railways have at present a very small representation in the list of members of the Canadian Electrical Association, and it seems a great pity that before segregating themselves in a street railway association they should not try whether the existing association will not fill the need they are beginning to feel. Electric street railways really occupy a central position amongst telegraph, telephone, light and power and manufacturing enterprises. Some of these have apparently very little in common with each other, but all of them come more or less into contact with the street railways. They are all well represented in the Canadian Electrical Association, which now needs only an increase in the number of its street railway members to be completely representative of all classes of electrical enterprise in Canada. All electrical interests, however dissimilar at first sight, have much in common. Like it or dislike it, they cannot help reacting upon each other, but it is in their own hands whether they endeavor to make this interdependence a help, or suffer it to become a hindrance, and it is here that the benefit comes in of beginning by a general association whose objects, as stated in the constitution of the C. E. A., are "to foster and encourage the science of electricity and promote the interests of those engaged in any electrical enterprise, and for the discussion and interchange of opinion among its members." Such an association is an endeavor to modify the natural narrowness which comes to all of us when we each know our own business and are each struggling for our own profit, and when in the obviousness of the points of difference between us and other strugglers, we are prone to lose sight of what we have in common, and regard contact as synonomous with conflict. To begin by class associations is to intensify this narrowness. To begin by a general association is to first try what profit we can derive from intercourse and such common action as is possible with those engaged in making a living in kindred occupations. Following on this the subsequent organization of special associations will come naturally as the outgrowth of healthy business development; but their membership overlapping with that of the general parent association should preserve them from the unprofitable narrowness of isolation. Whether a Street Railway Association is organized in the near future or not, we trust that the September meeting of the Canadian Electrical Association will show a large addition in the list of members interested or employed in electric street railway work.

QUESTIONS AND ANSWERS.

BELLEVILLE, ONT., June 30th, 1894.

Editor CANADIAN ELECTRICAL NEWS.

SIR,—A water power is situated two miles from our pumping station; could these pumps be run by electricity generated at our water power and what would be the percentage of waste in conveying electricity that distance?

Could our pumps (Henry R. Worthington, New York) be arranged to change easily from steam, as run now, to electric motor, or vice versa? Our water power may any year fail for a month or so.

Yours truly,

M. M. THOMPSON,
Supt. Belleville Water Works Co.

[Electrical power transmission for 2 miles is perfectly feasible. Percentage loss in line depends on voltage used and initial outlay for copper. Electric power could be applied to your pumps interchangeably with steam power. Both technically and commercially the best arrangement of plant for your case—including means of providing for varying pump delivery to mains under constant pressure—would depend largely on a number of local conditions. It would be a matter of skill and judgment applied to a detailed knowledge of your actual conditions, and would require careful planning by some competent electrical and mechanical engineer.—Ed. ELECTRICAL NEWS.]

A correspondent asks:—(1.) Is there a storage battery which has proved to be of service for carriage locomotion along ordinary highways? (2.) Why, when the brushes are raised up higher on the commutator, is the current reduced?

ANSWER.—(1.) Storage batteries have been frequently tried as a motive power both on highways and on surface railroads. As yet they have not proved a commercial success on railways owing to their weight and rapid deterioration—much less are they suited to propelling a carriage on an ordinary highway. (2.) When the brushes of a dynamo are moved forward of the neutral point or point of commutation a smaller electromotive force is made available owing to fewer coils of the armature being in the active field of the machine.

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138 Drolet Street, MONTREAL, July 7, 1894.

Editor ELECTRICAL NEWS.

SIR,—Since you invite correspondence, and wishing to advance the value of your paper, I take the liberty of drawing your attention to an item in your July issue, which does not reflect much credit on your informant's ability.

At bottom of page 83 "W. N." Hamilton, Ont., writes—"What size storage battery would I require to run 20 inc. lamps ½ ampere each?"

Now this can not be solved so easily as the answer given, because were only 55 cells used, the lamps would scarcely show they existed in the dark. The answer given and were it correct, and the battery short circuited through no external resistance, the result would probably be an explosion, in which the battery would be instantly consumed, through having no internal resistance. I will now endeavor to show how far the answer given is in error—just by the simple fact of not allowing for the internal resistance of the battery.

Assume each cell to have E. M. F. = 2 volts.
" " " " resistance = one-tenth ohms.

then by Ohm's Law $C=\frac{E}{R}$— or volts ÷ ohms = current — this equals—20 amperes; this is the current one cell would give through no external resistance, on short circuit.

One 110 volt lamp, ½ amp. of current has resistance of 220 ohms.
and 20 lamps in parallel = 11 ohms.
20 lamps require 10 amperes current.

Now for the number of cells in series, required to give the proper E. M. F. we have the following:

$$\frac{\text{Volts required in external circuit.}}{\text{Volts of 1 cell—(amperes required} \times \text{resistance of 1 cell).}}$$

or $\frac{110}{2-(10\times 1)}$ = 110 cells in series, which is somewhat more than the answer given. Of course the result is affected by the internal resistance of the battery.

Now for the proof:
external resistance (lamps) = 11 ohms.
110 cells one-tenth ohm each = 11 ohms.
E. M. F. of 110 cells 2 volts each = 220 volts.

$C=\frac{E=220}{R=22}$ = 10 amperes = the current required for the lamps—

Trusting that I have made this sufficiently plain to enable any calculation to be made that may arise, I have the honor to remain.

Yours truly,

JAMES WRIGHT.

N. B.—I forgot to mention in my letter that the internal resistance of Planté's storage battery is .06 ohm. This would make the calculation $\frac{110}{2-(10\times .06)}$ = 79 cells (about) and very close to what would be actually required, as some energy would be lost in the necessary wiring, etc.

[The answer given "W. N.," Hamilton, Ont., is correct. Mr. Wright's mistake lies in his assumption of ·1 ohms per cell internal resistance. The greatest working resistance of 50 ampere-hour cell of any ordinary type would be about .01 ohms, which in case under consideration would give internal resistance 5% of lamp resistance. It is therefore one minor factor amongst several others, and negligible for the purpose of the inquiry. The scope and function of answers to correspondents preclude discussion of all factors implied irrespective of relative importance. Answers are necessarily brief statements, and only of facts material to what we understand is the information desired. We aim at answering adequately the questions our correspondents ask, but not questions they don't ask.—Editor ELEC. NEWS.]

PERSONAL.

Mr. J. E. Berkeley, of the Standard Electric Co., Ottawa, is at present on a visit to Europe.

Mr. James Kent, Superintendent of the C.P.R. Telegraph Co., is at present on a visit to St. John, Halifax, Cape Canso and North Sydney.

Mr. G. Osborne, Secretary of the Kingston Street Railway Co, narrowly escaped having his arm amputated, from falling from one of the company's cars a few days ago.

It is reported that Mr. J. W. Baker, who for thirty years has been in the employ of the G. N. W. Telegraph Co., will be appointed Bursar at the new asylum at Brockville, Ont.

Mr. J. J. Wright, manager of the Toronto Electric Light Co., and Mr. A. B. Smith, of the G. N. W. Telegraph Co., have just returned from a cruise on Lake Ontario, on board Mr. Wright's yacht, "The Electra."

The Babcock & Wilcox Co., with Canadian head-quarters at Montreal, have just placed an order with the Dominion Coal Company, Sydney, C. B., for boilers aggregating 416 h. p. These boilers are now being manufactured in Canada.

It is announced to be the intention of the Toronto Railway Co., to immediately erect a large power house on Roncesvalle ave., near High Park, from which to supply power for the operation of the Mimico and Weston system. The site for the building is said to have been purchased, having a frontage of 250 feet on Roncesvalles ave., by a depth of 250 feet immediately north of Queen street, on the north side.

ELECTRIC RAILWAY DEPARTMENT.

THE GALT AND PRESTON ELECTRIC RAILWAY.

FOUR years ago, Mr. R. G. Cox, of St. Catharines, perceiving as he believed a promising business outlook for an electric railway which should connect the towns of Galt and Preston, set to work to arouse the interest of business men of the locality in the project. In this he so well succeeded that a company was shortly afterwards formed with the purpose of carrying out the undertaking. The management of the company was vested in the following officials: President, Thos. Todd; Vice-president, R. G. Cox; Secretary-treasurer, W. H. Lutz; Directors, Fred Clare, J. D. Moore, M.P.P., Hugh McCulloch, sr., and D. Spiers. These gentlemen have succeeded, though not without considerable difficulty, in carrying the enterprise to a successful completion. The chief difficulty encountered was the refusal of the municipality of Preston to grant the company right of way over the streets. No opposition of this nature was experienced from the three other municipalities through which the route of the railway lay. The opposition at Preston was due to belief on the part of some of the influential merchants and other business firms that the construction of the road would tend to divert trade from Preston to Galt. It took three years of persistent effort on the part of the company to dispel this belief and the opposition founded thereupon, but the task was eventually accomplished and the long-delayed franchise granted.

Early in the present year a contract was let for the construction and partial equipment of the road, to Messrs. Ahearn & Soper, of Ottawa, Canadian agents for the Westinghouse Electric Manufacturing Co., of Pittsburgh. The outside construction was done under the superintendence of Mr. Hartnett, of Toronto, while Mr. John Murphy, superintendent for Messrs. Ahearn & Soper, supervised the installation of the plant at the power station. The contract for the necessary steam plant was given to the Goldie & McCulloch Co., of Galt.

The railway company were fortunate in having the opportunity to purchase the required quantity of 56 lb. T-rails, second-hand, though in first-class condition, at a substantial reduction on the price of new material. The construction of the road began early in April, and was brought to completion about the middle of July. On Thursday, July 26th, the official opening took place, and was participated in by a number of invited guests as well as the officials of the road and prominent business men of the locality. Whatever clouds shadowed the enterprise in its earlier days, none were to be discerned on this occasion. The face of the sky as well as the faces of all who witnessed the ceremonies, seemed to smile approval.

At the Galt terminus of the line, situated close beside the G. T. R. depot, a couple of cars gaily decorated with flags, were in waiting on the arrival of the train from Toronto, to carry the officials and invited guests over the line, which is about three and a half miles in length. This distance, including stoppages, is covered in about fifteen minutes. The road, as stated, commences near the G. T. R. depot, and runs through the principal street of the town of Galt, to the C. P. R. depot, which is reached by a steep grade, and thence, following the highway, through the open country to Preston. The road is comparatively level, with the exception of three heavy grades, one of which has just been mentioned. Of the other two, one is situated in Preston and the other midway on the line. There is only one sharp curve, situated near the Galt terminus. The tracks are ballasted with gravel, and the road-bed is very solid and substantial in character. The line throughout is bonded with No. 0 wire. There are no ground plates and no return wires. No. 00 feed wires run the whole length of the line, with feeder to trolley wire every sixth pole. The span wire is of ordinary feed wire, the bell being of solid iron, not insulated.

The road is at present equipped with only two cars—one fitted up as an ordinary street car, the other with reversible cushioned seats on iron frames, after the style of a railway coach. A novel feature of this last mentioned car is the passenger baggage department, in the rear, which occupies about one-third of the interior space. The cars are vestibuled, and lighted by two clusters of incandescent lamps pendant from the ceiling. The cars were made at the works of the Ottawa Car Company.

The power station, where a halt was made to allow of an inspection of the motive power, is situated on the outskirts of Preston. It consists of a substantial stone building which, though originally built for other uses, has been remodelled and conveniently adapted for its present purpose. Attached to the boiler house in the rear there has been constructed on a stone foundation a brick chimney 80 feet in height and measuring about 9 feet square at the base. In the boiler house are two boilers, each 80 h. p. of steam. These supply steam to two compound Wheelock engines, each of 150 h. p., in the front of the building. These engines were manufactured by the Goldie & McCulloch Co., of Galt, and display excellent workmanship. They are joined by a coupling on center of shaft, and can be run singly or connected as desired. At present only one engine is required. The regulation of these engines is said to be so close that there is a variation of only 5 to 10 volts. These engines are belted to a No. 7 Westinghouse 85 Killowatt generator running at 175 amperes. But little more than half the capacity of this generator has thus far been brought into use. The company anticipate, however, that the road will be extended to Hespeler, three miles north of Preston, in which case it is believed the capacity of the present power plant would be found to be sufficient to meet the added requirements.

Water for condensing purposes is obtained from a creek which flows close beside the boiler house, and which is fed by never-failing springs. This water passes through a Northey jet condenser located in the basement of the building. Attached to the Northey pump is an automatic vacuum breaker, which prevents the water from rising too far. The generator is driven by 100 feet of 14 inch double ply belt supplied by the F. E. Dixon Co., of Toronto. There is now being put in a Wurtz tank lightning arrester with set of choking coils. It consists of four panels, each containing four coils of 10 turns of trolley wire. Every coil is connected with the water in the tank, the tank being grounded. The switch board, which is of oak, and rather unsubstantial looking in appearance, is fitted with a handsome set of Westinghouse recording instruments, switches, and a Wurtz non-arcing lightning arrester, separately mounted on blocks of marble. The arrester consists of two blocks of lignum vitae, carrying two brass plates, ¼ inch apart. Between these plates are fine lines burnt on the blocks, so that a path is carbonized for the discharge, which passes off without arcing. The cover is of lightnum vitae, and the size of the arrester 3½ square inches. The arrester requires no attention. The company have placed these arresters, encased in iron, at intervals along the line.

The plant is efficiently operated under the direction of Mr. W. A. Lea, formerly with the Toronto City and Suburban Electric Railway Company.

For the present the two cars running on the line are housed in one side of the power station, but the erection of a car barn adjoining the station is in contemplation. It is also intended to add to the present car equipment two trailers.

The Company are giving at present a half hour service between Galt and Preston, and by the terms of their franchise are compelled to meet all C. P. R. trains on their arrival at Galt. The gauge of the electric railway corresponds to that of the C. P. R., and a switch has been put in connecting the two roads at the C. P. R. depot, with the intention of hauling freight at night over the electric railway tracks by means of a dummy engine. It is believed that in addition to a profitable passenger traffic the road will do a large freight business.

After leaving the power station the trip was resumed. The widening of a bridge on the principal street of Preston at present stands as an obstacle to the running of cars through the town. The tracks have been laid to either side of the bridge, however, and immediately that the structure is widened to admit of carrying the railway tracks, traffic from end to end of the line will begin.

Beneath the shade of a mammoth tent pitched on the lawn of the Hotel del Monte, the company were invited to partake of a tastefully prepared luncheon, presided over by Mr. Todd, the president of the road. Following the repast there were in response to a brief toast list some excellent speeches, in which well merited praise was bestowed on the management of the company and the contractors for the energy and skill displayed in the construction of the road, and cordial wishes expressed for the prosperity of the enterprise. On behalf of the directors, Mr. Cox, the vice-president, presented to the president a life pass over the road, consisting of a card of pure silver, handsomely engraved.

There is little doubt that in the near future the Galt and Preston Electric Railway will be extended to Hespeler, which is quite an important manufacturing town, and from which a large amount of passenger and freight business would be derived.

A new fire alarm service, with twelve stations, is being put in by the corporation of Collingwood, Ont. Mr. Scott, of Oshawa, is doing the work under contract. The alarm, besides being connected to the central station, will connect at the city hall with a large bell, which rings the alarm.

The Ottawa Electric Street Railway carried during the first year of its operation 1,520,000 passengers. During the year ending May, 1894, the number of fares registered was 2,700,000. The equipment of the road consists of 65 cars, including three postal cars, which are operated by 1,700 h. p.; employment is given to 200 men.

Mr. J. N. Taylor has an article on "The Romance of the Telegraph" in Donahue's Magazine in the course of which he relates an anecdote of an old French Canadian woman who spent half a day gazing at the telegraph wires that stretched along in front of the little old house in which she lived. She was watching for a message, and a passer by, who was attracted by the old lady's attitude, asked her what she was looking at, and if she expected to see something pass on the wires, to which she replied: "Dere's long taime ah'll look does ting, me sometaime morneen', sometime heev'nin,' but ah'll nevair see someting go pass on 'eem. How ees dat? W'en an look long taime, by'm bye he's mek sometaime curieuse noise lak sing, deh ah spose he's hurry fas' as caint see someting any more? Ah don honderstan' me."

WINNIPEG STREET RAILWAY COMPANY V. WINNIPEG ELECTRIC STREET RAILWAY COMPANY AND THE CITY OF WINNIPEG.

BEFORE the Judicial Committee of the Privy Council at the beginning of July an appeal from a judgment of the Court of Queen's Bench in Manitoba in the above case was heard. The case was recently argued before a Board consisting of the Lord Chancellor, Lord Watson, Lord Macnaughten, and Sir Richard Couch, when judgment was reserved. Lord Watson, in now delivering judgment, went fully into the question at issue between the parties. The action was originally brought to secure certain rights claimed by the appellant Company under a deed of indenture executed in July 1882, between the appellants and the authorities of the city of Winnipeg for the construction and working of street railways within that city. Having very exhaustively reviewed the evidence, his Lordship said that the privileges conceded to the appellant Company were to endure for 25 years from the date of the deed of indenture executed in July, 1882, it being in the option of the city to acquire the Company's undertaking at the expiry of that period upon their giving five years' previous notice to that effect. The Company at once proceeded with their tramway enterprise, in accordance with the terms of the said deed, which gave the appellant Company powers to use and occupy such parts of the streets of the city as were necessary for the use and working of their railways. Before 1892 they had completed and were in course of working upwards of nine miles of street railways. In Feburary, 1892, the Mayor and Council of Winnipeg passed a by-law authorizing James Ross and William M'Kenzie to construct railways upon the streets of the city. The respondent Company in April, 1892, obtained an Act of the Provincial Legislature, incorporating them for the purpose of their taking over the rights acquired by Ross and M'Kenzie, and carrying out the scheme sanctioned by the by-law of February. The respondent Company's Bill was opposed by the appellant Company, who alleged that they were entitled to a monopoly for the period of 25 years from the date of their agreement of all those streets in which their railways had already been open for traffic, and also of certain other streets in which they had intimated that they were willing and ready to construct and operate railways. This right was (the appellant contended) specially safeguarded by a clause in the Company's Act. It was (said his Lordship) unnecessary to criticise the enactments of this clause, because it was not disputed that these would be sufficient to protect any such privilege as that which was claimed by the appellant Company in the appeal. The appellants commenced the present suit by presenting to the Court of Queen's Bench a bill of complaint against the respondent Company and also against the city of Winnipeg. The appellants craved a declaration of the exclusive rights which they claimed against both respondents, and an injunction restraining the respondent Company from constructing or operating railways in any street occupied by them until an offer had been made to them of the privilege of constructing a railway upon it and had not been accepted by them within two months. In defence to the suit the respondents maintained, in the first place, that the appellant Company were not possessed of any exclusive privilege, and that the city had therefore power to sanction the construction of railways by the respondent Company, in any street of the city, whether it was already occupied by the Company or not; and, in the second place, that, if the city had in fact agreed to give the appellant Company a monopoly of the railway traffic in certain streets, the agreement was *ultira vires* and void. The original action had been decided against the appellants, as had also an appeal before a full Court. In the full Court both points were decided against the appellants. Their Lordships did not find a single expression tending to show that the Legislature either intended that no tramways other than those of the appellant Company were to occupy the streets of Winnipeg or had it in contemplation that the appellants were to obtain a monopoly from the Council of the city. If such a claim were valid, the right must be derived from the indenture of 1882; but the only authority there given was expressly limited to the construction, maintenance, and operation in each street which the Company might select for that purpose, of a railway consisting of a single or double line of rails, with needful appurtenances; "and such railway shall have the exclusive right of such portion of any street or streets as shall be occupied by the said railway, and shall be worked under such regulations as may be necessary for the protection of the citizens of said city." The appellant Company argued that the words last quoted ought to be cosntrued as a declaration that the Company's railway was to be the only railway permitted to occupy any part of those streets into which it might be introduced by them. In their Lordships' opinion, any such construction would be contrary to the plain meaning of the words of the agreement, which in substance implied that the Company were to have no use or occupation of, and no concern with, those portions of any street which were not actually occupied by their double or single line of rails. The only clause at all bearing out the appellant's connection ran thus:—"In the event of any other parties proposing to construct street railways on any of the streets not occupied by the parties to whom the privilege is now to be granted, the nature of the proposal thus made shall be communicated to them, and the option of constructing such proposed railway on similar conditions as are herein stipulated shall be offered; but if such preference is not accepted within two months then the Corporation may grant the privilege to any other parties." Their Lordships did not think that it was going too far to say that, laying aside the terms of that stipulation, there was not a single expression in the deed of agreement which gave the least countenance to the suggestion that the Municipal Council intended to grant to the appellants an exclusive right to use and occupy any street for railway purposes. Those clauses of the deed which dealt directly with the use and occupation of the streets which were to be enjoyed by the company were not only silent upon the question of exclusive right, but were conceived in terms which it was exceedingly difficult to reconcile with the theory of an intention to create such a right. Had there been any such intention, nothing would have been easier than to indicate its existence, in the proper place, either expressly or by implication. Their Lordships were therefore of opinion that the leading clauses of the agreement which defined the Company's rights of user and occupation, could not be qualified by a subsidiary clause, such as that upon which the appellant Company relied, unless its terms were clear and coercive. They were unable to hold that the terms of the clause in question were in themselves sufficient to control the plain meaning of the previous stipulations and to constitute the right of monopoly which the appellant Company claimed. The clause could not imply an undertaking on the part of the council that in the event of a rival company obtaining statutory powers, and desiring to compete with the appellant Company in those streets in which their system had already been established, the Council should be bound, although against the interest of the community which it represented, to refuse its assent to the new scheme and to allow the Company to remain in the enjoyment of a monopoly. Their Lordships' decision, therefore, was that the judgments appealed from ought to be affirmed, and the appellant Company must pay one set of costs to the respondents.

TESTS OF SMALL ELECTRIC RAILWAY PLANTS.*

By Jesse M. Smith.

THIS paper gives the results of a test made in October, 1893, on the power plant of the Wyandotte & Detroit River Railroad, which is a suburban road running from Detroit to Trenton, Mich., 10.5 miles long.

The plant contains too tandem compound condensing engines, rated at 150 H. P. each, and guaranteed for a maximum load of 225 H. P., made by the Phœnix Iron Works Company, Meadville, Pa. Each engine is belted direct to a Westinghouse railway generator of 150 E. H. P. The vacuum is obtained by a Conover air pump and condenser belted directly to the engine shaft. The boiler feed pump is driven from the air pump shaft. Steam is supplied by two Manning vertical boilers. One engine and dynamo only were used during the test. It will be noted at the outset that each engine and dynamo are designed to deliver an average of 150 H. P., but that during the test the average load on the engine was only 70 I. H. P. and the maximum 141 I. H. P. The best conditions of economy were therefore not realized. The test was made under commercial conditions for the owners of the plant. All the machinery had been run about three months and no adjustments by the makers had been made since it was first put in. No special care had been taken to get very close regulation either of the engine or generator. One boiler was fired with coal, and used exclusively to supply steam for the fuel atomizer of the other boiler; "straight crude oil" was used exclusively as fuel for the boiler, which supplied steam to the engine, and no steam was used from that boiler for other purposes. Indicator cards were taken at intervals of five minutes during the 17½ hours of the test. A Tabor indicator was applied directly to each end of each cylinder, and all operated by the same mechanism. Indicator cards were taken simultaneously from the four indicators by two persons on a signal given at the proper time, without regard to the load on the engine. The speed of the engine was determined by a continuous revolution counter which was directly connected to the shaft of the engine. The variation of speed was shown by a tachometer belted directly to the engine shaft, and constantly in service. It was carefully compared with the revolution counter when on constant speed, and was made to agree with the counter. The speed of the dynamo was taken at four different times by a revolution counter held in the end of the shaft for five consecutive minutes each time. Three readings gave 604 revolutions, and one reading gave 603 revolutions per minute. The speed of the air pump was taken in the same way.

The steam gauges on the boilers were connected to the boiler near the bottom, so that they show the pressure due to a head of water of about ten feet in addition to the steam pressure. The boiler gauges therefore show about five pounds more pressure than the pressure of the steam in the boiler. The standard gauge, when placed on the steam pipe of the engine just above the throttle valve, showed about five pounds less pressure than the boiler gauge, so that there was practically no loss of steam pressure between the boiler and engine.

The amperes were measured by a Weston standard ammeter connected in series with the station ammeter. The volts were measured by a Weston standard voltmeter connected to the bus bars of the switchboard. Volt and ampere readings were taken every ten seconds by a different person at each instrument, the time being given by a third person.

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* Abstract of a paper read before the American Society of Mechanical Engineers.

The water used by the boilers was taken from the overflow of the air pump, and weighed in two barrels on two scales, and was pumped from the barrels by the regular feed pump worked from the shaft of the air pump. The feedwater passed through a closed heater with brass tubes, the heater being connected with the exhaust pipe between the engine and condenser. The fuel oil was stored and fed by the Snell water pressure system. The amount of fuel oil fed to the atomizer was measured by measuring the number of gallons of water which flowed into the storage tank.

The dimensions of the plant and data, and the results, are given in the following tables :

BOILERS.—Kind, Manning vertical tubular ; number, 2; size, known as 61 inches ; rated capacity, 150 H. P ; inside diameter of firebox, 6 feet ; height above grate, 3 feet 6 inches ; number of tubes 184 ; outside diameter of tubes, 2½ inches ; total length of tubes, 14 feet 10 inches ; length of tubes below water line, 10 feet 7 inches ; heating surface in firebox, 89.2 square feet ; heating surface in tubes below water line, 1,272.7 square feet ; heating surface in tubes above water line, 511.1 square feet.

ENGINE.—Kind, Phœnix Iron Works Company, tandem compound, condensing ; diameter of high pressure cylinder, 11 1-16 inches ; diameter of low pressure cylinder, 20 1-32 inches ; stroke of piston, 15 inches ; piston valves on both cylinders, both controlled by shaft governors ; number of fly-wheels, 2 ; diameter of fly-wheels, 78⅜ inches ; face of fly-wheels, 16⅝ inches ; weight of rim of each fly-wheel, 2,445 lbs.

AIR PUMP.—Kind, Conover belted to engine ; size, No. 7 ; diameter of piston, 15 inches ; stroke of piston, 7 inches ; revolutions per minute, 67.

BOILER FEED PUMP.—Kind, single acting plunger driven from shaft of air pump ; diameter of plunger, 3 inches ; stroke 6 inches.

DYNAMO.—Kind, Westinghouse four pole railway generator ; rated capacity, 150 E. H. P. ; standard speed, 625 revolutions per minute ; speed when tested 604 revolutions per minute.

CARS.—Maker, Jones ; length, 16 feet ; weight, 14,500 pounds ; number of seats 22 ; kind of motors, Westinghouse ; number of motors, 2 ; rated power of each motor, 30 E. H. P. ; number of cars in use, 3.

ROAD.—Length, 10.5 miles ; kind of rail, T ; weight of rail per yard, 52 and 56 pounds ; supported on cross ties ; ties covered with sand, and resting on sand, except from Wyandotte to Trenton, which is stone ballasted.

SPEED OF ENGINE AS CONTROLLED BY GOVERNOR.

Revolutions per minute by revolution counter, average for eight minutes with dynamo belt off	238 revolutions
Average revolutions per minute on regular work during 362 minutes	234.3 "
Per centage of variation of revolutions	1.58 "
Minimum revolutions per minute, dynamo producing 180 amperes, engine developing 165 I. H. P	227 "

DISTRIBUTION OF POWER USED.

Power consumed by friction of engine, air pump and boiler feed pump, with main belt off	9.22 I. H. P.
Friction of engine, air and feed pumps, and dynamo, with brushes off	11.34 I. H. P.
Friction of dynamo and belt	2.12 I. H. P.
Power consumed by engine, air and feed pumps and dynamo, with brushes on and main circuit open	14.34 I. H. P.
Power required to charge fields of dynamo	3.00 I. H. P.
Percentage of engine capacity required by friction of engine, air and feed pumps	6.15
Maximum power developed by engine as shown by indicator cards, during economy test	141.4 I. H. P.
Minimum power developed by engine as shown by indicator cards, during economy test	21.27 I. H. P.
Average power developed by engine, as shown by 208 sets of indicator cards, during economy test	70.1 I. H. P.
Average electrical horse power delivered by dynamo	45 E. H. P.
Average indicated horse power delivered to pulley of dynamo, estimating friction of armature shaft to be the same as friction of belt	59.81 H. P.
Average number of cars in use during test	2.89 cars
Number of passengers on cars during 17½ hours	1,014
Average number of passengers on car per single trip	15.2
Average number of passengers on cars at any one time (estimated)	8
Weight of 10 persons at 140 lbs each	1,400 pounds
Weight of cars	14,500 "
Total weight of cars and persons	15,900 lbs.
Average weight in motion	44,950 "
Average electrical horse power per 1,000 pounds of weight moved	0.98 E. H. P.
Average horse power developed by engine per 1,000 lbs. of weight moved	1.52 I. H. P.
Average electrical horse power per car	15.54 E. H. P.
Average horse power developed in engine per car	24.25 I. H. P.
Average watts delivered by dynamo per horse power developed in engine	478.8 watts
Average watts delivered by dynamo per horse power delivered to belt of dynamo	557.3 watts
Average speed of cars per hour, including all stops, 21 miles in 1.5 hours	14 miles p'r h'r
Average speed of cars between stops	15.38 " "
Total car hours	50.25 hours
Time of test	17.33 "

ECONOMY TEST.

Duration of test	17⅓ hours
Average horse power developed in engine as shown by 208 sets of indicator cards taken at five-minute intervals	70.1 I. H. P.
Average horse power delivered by dynamo as shown by 6,209 sets of readings taken at ten-second intervals	45 E. H. P.
Net average steam pressure in boiler by ½-hour readings	111.8 lbs.
Average vacuum by half-hour readings	25.2 ins.
Steam used by engine per hour	1,721.1 lbs.
Steam used by engine per horse power per hour	24.55 "
Steam used by fuel oil jet per hour	291.5 "
Steam used by engine and fuel oil jet per hour	2,008.8 "
Per centage of steam used by fuel oil jet	14.5
Fuel oil used per hour for engine, 20.25 gals	133 lbs.
Fuel oil used per horse power per hour for engine, 29 gals	1.9 lbs.
Additional fuel oil which would be required to maintain oil jet for one hour, 3.43 gals	22.58 "
Average temperature of water flowing from air pump	91.8 Fah.
Average temperature of feedwater entering boiler	126.6° "
Rise of temperature of feedwater due to heater	34.8° "
Per centage of fuel saved by heater	3.06%
Fuel oil required to evaporate 1,000 lbs, of water from 126.6° Fah. into steam at 112 lbs. pressure	11.79 gals.
Water evaporated from 126.6° Fah. into steam at 112 lbs. pressure per gallon of fuel oil	84.81 "
Ditto per pound of oil	12.9 lbs.
Area of steam outlet of atomizer	.07 sq. in.
Which is same as a round hole .3 in. diameter	

It will be noted that 14.5 per cent. of the total steam generated was used by the fuel oil atomizer. The atomizer was not properly proportioned for the work, and did not receive enough air. The flame was red and evidently not economical. The atomizer and furnace have since been arranged with much better results.

In this engine the piston valves which distribute the steam to both high and low pressure cylinders are controlled by the governor.

It will be noted that while this is a condensing engine the high pressure cylinder does a good share of the work even on the lightest loads, and the receiver pressure does not vary greatly either during a single revolution, or during a change of load of from 21 to 101.8 H. P. While the load changes 488 per cent., the average receiver pressure only changes 167 per cent., and even when the engine ran with the belt off and developed 9.2 H. P., there was no negative work in either end of either cylinder. These results, which I believe to be highly important, both for economy and close regulation, are due to the valves of both cylinders being controlled by the governor.

The results of a study of the indicator diagrams are given in the following table :

	Set No. 1.	Set No. 2.	Set No. 3.
I. H. P. in H. P. cylinder			
Crank end	2.4	13.8	25.3
Head end	2.5	14.8	26.1
I. H. P. in L. P. cylinder			
Crank end	8.3	16.6	25.2
Head end	7.8	17.6	25.2
Total I. H. P	21.0	62.8	101.8
Maximum pressure in receiver	5.9	9.0	11.0
Minimum " "	4.0	6.4	7.5
Average " "	4.9	7.2	8.2

The variations in load in a plant of this kind are not only extreme but rapid, and were from 5 to 134 amperes. In one interval of 10 seconds the load increased 115 amperes, which equals 120 I. H. P.

During the regular operation of the plant and with these extreme variations in load, the needle of the tachometer never left the space enclosed by the 230 and 240 revolution marks.

FLY WHEELS.

For convenience of those designing or buying steam engines, we give herewith a table applicable to engines of various horse powers, ot different speeds, and from which the required weight of fly-wheel rim in pounds may be got by dividing the number given by the diameter of wheel decided upon. The larger the wheel the less rim-weight it needs.

TABLE FROM WHICH TO GET WEIGHTS OF FLY WHEEL RIMS.

	REVOLUTIONS PER MINUTE,			
H. P.	60	70	80	90
	Constant	Constant	Constant	Constant
25	45126	33163	25391	20111
30	54152	39796	30469	24133
40	72202	53061	40625	32178
50	90253	66327	50781	40222
60	108303	79592	60938	48266
70	126354	92857	71094	56301
75	135379	99490	76172	60333
80	144404	106122	81250	64365
90	162455	119388	91406	72400
100	180505	132654	101563	80444
125	225631	165816	126953	100555
150	270758	198980	152343	120666
175	315884	232143	177734	140767
200	361010	265306	203135	160888
225	406136	298469	228516	180999

THE GEAR BUSINESS.

THE gear business has grown to be quite extensive, so much so that one of the firms in this line has decided to secure a patent on bevel gears with plain surfaces for the flanks of the gear teeth. It may be that this firm has a special curve of their own to run with a straight flank tooth, but if they will look into the theory of the matter they will find that there is only one form that will work properly with a straight flank, and that form is determined by the flanks themselves, without any discovery being needed from any source.—Journal of Commerce.

SPARKS.

An electric railroad from Chatham to Fort Lambton, via Dover, is talked of.

Telephonic communication was recently established between Guelph and Chicago, a distance of 600 miles.

The Winnipeg Electric Street Railway Co. have decided to issue transfers over their entire system at one fare.

It is said to be the intention of the Wellington Coal Co., of Nanaimo, B.C., to install an electric plant in their mines.

The management of the Light, Heat & Power Co., of Kingston, Ont., has recently been placed in the hands of Mr. B W. Folger.

By the narrow majority of five, the ratepayers of Orillia have approved the expenditure of $13,000 on an incandescent lighting system.

A by-law authorizing the purchase by the city of Vancouver, of the electric railway at that place, has been disapproved of by vote of the ratepayers.

The application for incorporation of the Niagara Falls Electric Bridge Co., which was recently before the Dominion Parliament, has been withdrawn.

The ratepayers of Weston have expressed approval of the granting of a bonus for the extension of the Toronto Suburban Railway to that village.

The agreement between the corporation of Ottawa and the Ottawa Electric Co., for the city lighting for a period of ten years, has been formally concluded.

There has recently been a change in the Montreal Electric Co., Mr. W. F. Taylor having retired. The business will be continued by Messrs. John and Wm. B. Shaw.

Messrs. F. H. Sleeper & Co., of Coaticook, Que., are endeavoring to form a company to supply electric light to the village of Ormstown and the town of Huntingdon.

Mr. George W. Kiely, formerly President of the Toronto Railway Co., died suddenly at his residence in Toronto on July 18th. Mr. Kiely very highly respected in the community.

The Hamilton papers look upon the completion of the Galt & Preston Railway as an indication that the proposed Hamilton Radial Electric Railway project will be successfully carried out.

The Electric Light and Water Supply Co., of Gananoque, Ont., are said to have under consideration the construction of an electric railway from that town to Gananoque Junction, a distance of four miles.

The engine in the Kingston Electric Railway Company's power house was damaged by lightning on the 2nd of July to such an extent that the operation of the street cars was delayed until the following day.

At the twenty-fifth annual meeting of shareholders of the Dominion Telegraph Co., held in Toronto on July the 11th, Mr. Thos. Swinburne was re-appointed President, Sir Frank Smith, Vice-President, and Mr. Fred Roper, Sec.-Treas.

The Nova Scotia Telephone Co. has recently established communication with Maitland, via Truro. The line extends through Clifton and Black Rock, and from thence to Maitland by means of a submarine cable, 3,500 feet long, crossing the river.

The offer of the Canadian General Electric Co. to light the streets of London with arc lights at 25 cents per light per night, has been accepted by the City Council. The offer of Mr. T. H. Everett, for the electric street railway franchise was not entertained.

The Dominion Parliament has granted incorporation to the Boynton Bicycle Electric Railway Co., which purposes to run from Winnipeg via Toronto, Ottawa, Montreal and St. John to Louisburg, Cape Breton county, N. S., and from Montreal to Quebec.

The Chief of Police of Montreal has been instructed by the Council to cause the arrest of any motor-man who runs his car at a faster rate than eight miles an hour. It will be interesting to learn in what way the police will determine at what rate the cars are run.

The City Council of Victoria, B. C., is considering the question of a suitable site for the electric power house which it is proposed to erect. It is suggested that arrangements should be made in connection with the erection of this station for the cremation of the city garbage.

A Keewatin dispatch states that the Power Company of that place are talking of making the attempt to furnish electric power to Winnipeg, a distance of 100 miles. The company will do well to wait the result of the Cataract Construction Co.'s efforts on this line, before proceeding with the experiment.

Several officers of the Toronto, Montreal and Cleveland railway syndicate, with Mr. Sam Hughes, M.P., of Lindsay, have been incorporated as the "Hughes Car Ventilating Co., Limited," with a capital of half a million dollars, for the purpose of placing upon the market an invention by Mr. Hughes for the ventilation of cars.

The city council of Winnipeg will be petitioned to sanction the running of street cars on Sunday.

The Standard, Chaudiere & Ottawa Electric Light Companies have been formally amalgamated under the name of the Ottawa Electric Co. The officers of the new company are: President, Mr. T. Ahearn; vice-president, Hon. E. H. Bronson. The capital stock of the company is $1,000,000, with a paid-up capital of $645,000.

Negotiations are said to be in progress for the purchase by the Toronto Railway Co. of the Metropolitan Electric Railway at North Toronto, but it is stated that no agreement has been arrived at. It is denied that an injunction has been issued by some of the shareholders of the Metropolitan Railway Co. to prevent the consummation of the deal.

The construction of a belt line electric railway, three miles in length, at Nanaimo, B. C., with a continuous line six miles in length to the neighboring town of Wellington is proposed by Messrs. J. H. Brownlee and W. C. Haywood, of Victoria. It is proposed also to light the streets of Nanaimo. Wellington and Northfield. The cost of carrying out the proposal is estimated at $147,000. The interest on this sum the city will be asked to guarantee.

The Toronto Railway Co. have recently posted in their cars regulations forbidding passengers to attempt to alight from a car without previous notice to the conductor; to attempt to get on or off a car while it is in motion; to ride on platform or steps of cars, or lean on gates at side of cars; to cross tracks without stopping and looking for cars. The company will not entertain any claim which may arise from violatian or want of regard of any of these rules and warnings.

Two electric companies have secured incorporation at St. George, N. B. One is called the St. George Electric Co., Ltd., and is composed of T. H. Estabrooks, A. P. Barnhill and Dr. Wm Bayard, of St. John, and Hon. A. T. Dunn and F. B. Dunn, of Musquash. It has a capital stock of $5,000 in $100 shares, and one-half of the stock is preferred. The other is known as the St. George Electric Light and Power Co., with a capital stock of $5,000 in $10 shares. It is composed of St. George people—J. Sutton Clark, Timothy O'Brien, Andrew S. Baldwin, John Frawley, Dr. H. J. Taylor, James Bogue and John O'Brien.

The following gentlemen have been elected as the Board of Directors of the Hamilton and Dundas Railway Co., for the ensuing year: Messrs. B. B. Osler, Q. C., Adam Brown, Alex. Bruce, Q. C., George Bamberger, H. S. Osler, George S. Counsell, and John Garrett. At a meeting of directors held immediately afterwards, Mr. B. B. Osler, Q. C., was chosen president, Mr. Adam Brown, vice-president, and Mr. W. S. McBrayne, Secretary-treasurer. The conversion of the road to electricity was discussed, and progress was reported in the completion of the com-pany's arrangements in this direction.

Owing to right of way troubles the Hamilton, Grimsby and Beamsville Electric Railway is not expected to be ready to go into operation before September. Several wealthy farmers at Grimsby have yet to be settled with, probably by arbitration, and the procedure of the courts is conducted with great deliberation. The worst part of the grading has been done, viz., at Red Hill, where filling was required to a depth of 3 to 19 feet for a distance of 400 feet. The iron bridge at this point is now being erected. The power station building is completed and the engines are being erected. The generators have not yet arrived. Owing to the refusal of the county to grant the right of way, the road will be constructed only as far as Grimsby village this year, but the expectation is that an agreement will be reached with the county authorities under which the line will be extended to Grimsby Park.

TENDERS WANTED

Tenders will be received by the undersigned, until WEDNESDAY, the 15th August, 1894, for the erection and furnishing an

ELECTRIC LIGHT PLANT

including poles and wire, lamps, etc., etc. And for erecting a Power House on the water power owned by the Town of Trenton, to be owned and operated by the municipality.

Also a tender for lighting the Town of Trenton, the tender to state price separately, and to furnish their own plans and specifications.

Further information can be obtained from the undersigned. The lowest or any tender not necessarily accepted.

GEO. CROWE,
Chairman Fire, Market and Police Committee

Trenton, 25th July, 1894.

Parliament has sanctioned the bill providing for an increase in the capital stock of the Montreal-Park and Island Railway from $500,000 to $1,000,000. Mr. Williams, the promoter of the bonus for the road, has been granted $125,000 worth of stock in the company, as remuneration for his services.

SITUATION WANTED

Electrician and Engineer open for engagement; thoroughly understands management and repairs to machines and lamps, wiring, etc.; strictly temperate; references.

R BT. SAXBY, Jr.,
103 Walker ave., Toronto, Ont.

TENDERS

. . FOR . .

ELECTRIC LIGHT PLANT

Tenders will he received by registered post only, addressed to Ald. W. T. Stewart, chairman Committee on Fire and Light, Toronto, up to 11 o'clock a.m. of

Saturday, the 1st of September, 1894,

For the installation of a complete electric light plant for the

CITY OF TORONTO, ONT.

Separate tenders will be received for the various portions of the work, viz:

1. Engine Equipment.
2. Counter Shaft and Pulleys.
3. Belting.
4. Boilers.
5. Pumps and Steam Piping.
6. Economizers.
7. Dynamos and Station, Electrical Apparatus.
8. Arc Lamps.
9. Poles and Overhead Circuits.
10. Mast Arms and Lamp Attachments.

Plans and specifications may be seen and forms of tender obtained at the office of the City Engineer on and after Saturday, the 11th of August, 1894.

Specifications for items No. 2, 3, 5 and 6 may be withheld until balance of apparatus is decided upon.

A deposit in the form of a marked cheque, payable to the order of the City Treasurer, for the sum of 2½ per cent. on the value of the work tendered for, must accompany each and every tender, otherwise they will not be entertained. All tenders must bear the bona fide signatures of the contractor and his sureties (see specifications) or they will be ruled out as informal.

The committee do not bind themselves to accept the lowest or any tender.

W. T. STEWART,
Chairman Com. on Fire and Light.

Committee Room, Toronto, July 26, 1894.

TENDERS

For Lighting the Streets of the City of Toronto.

Tenders addressed to the undersigned will be received by registered post up to 12 o'clock noon of

SATURDAY, SEPTEMBER 1st, 1894,

For the lighting of the streets, avenues, squares, and lanes of the city of Toronto with electric light and gas for a period of five years from the 1st of January, 1896. Specifications and forms of tender can be obtained upon application at the office of the Secretary of the Fire Department, Bay street Fire Hall, on and after Wednesday, August 1st.

Cash deposit or marked cheque, made payable to the order of the City Treasurer for the sum of $3,000, must accompany each and every tender, together with the bona fide signatures of two responsible persons who will become sureties for the due fulfilment of the contract. The deposit accompanying the tender will be forfeited to the city in the event of the person or persons whose tender is accepted failing to execute the contract or give satisfactory sureties for the due fulfilment of the same. Deposits of unsuccessful tenderers will be returned.

Lowest or any tender not necessarily accepted.

W. T. STEWART,
Chairman Com. on Fire and Light.

City Clerk's Office, Toronto, July 27, 1894.

... THE ...

Canadian General Electric Company

LIMITED.

HEAD OFFICE:
65 to 71 Front Street West.
TORONTO, ONT.

CAPITAL,
$1,500,000.

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MOONLIGHT SCHEDULE FOR AUGUST.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	
1......	P. M. 7.30	A. M. 4.00	8.30
2......	" 7.30	" 4.00	8.30
3.	" 7.30	" 4.00	8.30
4......	" 7 30	" 4.00	8.30
5......	" 8.40	" 4.00	7.20
6......	" 9.10	" 4.00	6.50
7......	" 9.40	" 4.00	6.20
8	" 10.20	" 4.00	5.40
9......	" 11.00	" 4.10	5.10
10......	" 11.20	" 4.10	4.50
11......	" 11.50	....	4.20
12......	....	" 4.10	
13......	A.M. 12.50	" 4.10	3.20
14......	" 1.40	" 4.20	2.40
15......	No light.	No light.	....
16......	No light.	No light.	....
17......	No light.	No light.	....
18......	No light.	No light.	....
19......	P. M. 7.10	P. M. 9.30	2.20
20	" 7.10	" 10.10	3.00
21......	" 7.10	" 10.40	3.30
22......	" 7.10	" 11.20	4.10
23......	" 7.10	" 11.50	4.40
24......	" 7.10	A. M. 12.20	5.10
25	" 7.10	" 1.00	5.50
26......	" 7.10	" 1.10	6.00
27......	" 7.00	" 2.10	7.10
28......	" 7.00	" 3.30	8.30
29......	" 7.00	" 4.30	9.30
30......	" 7.00	" 4.30	9.30
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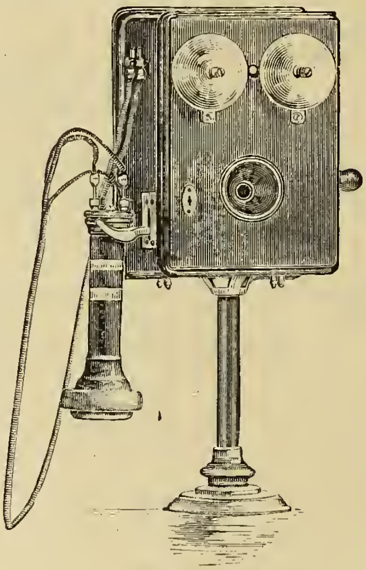

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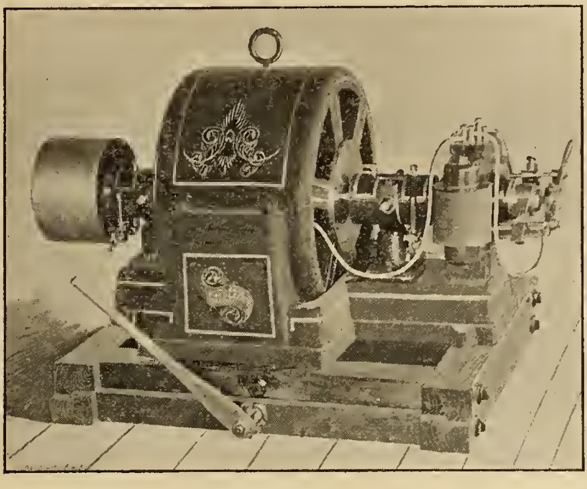

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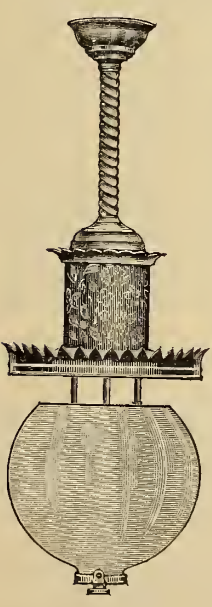

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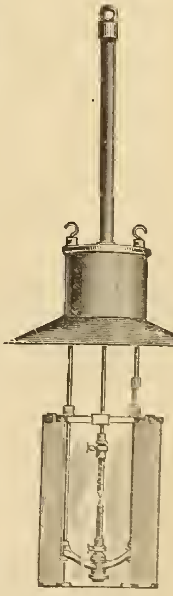

For street lighting.

BUSINESS TROUBLES.

We regret to be compelled to announce the failure, during the last month, of two of the best known Canadian electrical manufacturing companies, viz., the Reliance Company, of Waterford, Ont., and Messrs. T. W. Ness & Co., of Montreal. We hope to learn that it will be possible for these companies to make such arrangements with their creditors as will enable them to resume business at an early date.

SPARKS.

The telephone office at Romney, Ont., was recently destroyed by fire.

It is said to be the intention of Mr. Cone to install an electric light plant at Parry Sound.

The Toronto and Montreal railway companies have recently equipped many of their cars with fenders.

The construction of a telephone line from Eganville to Bulger, Ont., a distance of eight miles, is talked of.

The ratepayers of Kincardine have approved of a by-law for the expenditure of $10,000 on an electric light plant.

A telephone line has recently been opened for service between Lethbridge and Cordston, Alberta, a distance of 46 miles.

The Bell Telephone Co. have recently expended upwards of $10,000 on the improvement of its offices and plant at Kingston.

Notice is given of the intention of the Colonial Telegraph and Telephone Co., Limited, of Niagara Falls, to apply for incorporation.

The Seaforth Electric Light Co., has given a contract to the Johnston Electric Co., of Toronto, for a 1,000 light incandescent plant.

Messrs. Mills & Pettes are being complimented upon the satisfactory manner in which they are lighting the town of Knowlton, Que.

Mr. Simmonds, superintendent of the Kingston Electric Street Railway, has recently patented an invention for the electric lighting of trail cars.

Mr. W. H. McEvoy has given a contract to the Canadian General Electric Co. for a 500 light incandescent plant to be installed at Amherstburg, Ont.

Some Toronto capitalists are said to be interesting themselves in a project for the construction of an electric railway between Clinton and Bayfield, Ont.

The Brantford Electric Street Railway Co. are said to be negotiating for the purchase of a park on the outskirts of the city, with which the company's lines would be connected.

The Bell Telephone Co. are erecting a line of 40 foot poles between London and Stratford, which will complete a metallic circuit from London to Toronto, via Stratford and Guelph.

The new power house now in course of erection for the Montreal Street Railway Co., is expected to be completed early in the autumn. The building and equipment will cost about half a million dollars.

The question of the renewal of the Hamilton city lighting contract has again been before the council, but no conclusion has yet been reached. The matter will again be discussed at the next meeting of the council.

Mr. David A. Starr, who recently resigned the position of general sales agent for the Royal Electric Co., is at present in the West Indies, acting as consulting engineer to the Trinidad Electric Light and Power Co.

The town of Carleton Place is said to have withdrawn the bonus which was proposed to be given to Messrs. T. W. Ness & Co., of Montreal, in consideration of the removal of the company's works to that place.

Mr. Henry W. Darling, well known in Toronto as the ex-president of the Canadian Bank of Commerce and the Toronto Board of Trade, has recently been elected treasurer of the General Electric Co., in the United States.

It is believed to be unlikely that the Toronto and Scarboro Electric Railway Co. will extend their line to Little York, but the line will probably be extended to Queen street and there make connection with the city line near Victoria Park.

The town council of Galt have been looking into the question of operating their own electric lighing plant, and are said to have arrived at the conclusion that the cost by this method would be greater than under the present contract system.

It has been decided to submit a by-law to the ratepayers of the village of Lanark, empowering the council to grant a bonus of $5000 for the construction within two years of an electric railway to connect that place with either the C.P.R. or G.T.R. line.

The motor and repair shops at the Montreal Street Railway Co. will shortly be removed from Hochelaga to the company's building at Chenville and Vitre streets, where extensive alterations are now going on, with the view of adapting the buildings to the purpose.

A 30 years' franchise has been granted to the Trenton Electric Light Co. for the construction and operation of an electric street railway from the town to the Grand Trunk depot, with a loop line running through the town. The length of the road will be two and one-half miles.

The preliminary plans of the company which is about to construct works for the utilization of the water power on the Canadian side of Niagara Falls, are said to have been approved by the Queen Victoria Park Commissioners, so that it is expected the development of the scheme will be at once commenced.

The Stanstead Electric Light Co. has been incorporated with a capital stock of $25,000. The promoters of the company are:—Henry Lovell, Moody B. Lovell, Charles A. Lovell and Fritz E. Lovell, manufacturers, of Coaticook; Michael F. Hackett, John M. Le Moyne, Alfred N. Thompson, Henry E. Channell, of Stanstead Plain; and George F. Terrill, of Sherbrooke.

As the result of recent difficulties between the two companies, an action for $10,000 has been taken against the Merchants' Electric & General Service Co., Limited, by the Electric Surface Co., Limited, of Canada, at Montreal. The city of Montreal has also entered an action against the Montreal Street Railway Co., to recover $26,354, half the cost of clearing snow from the city streets during last winter.

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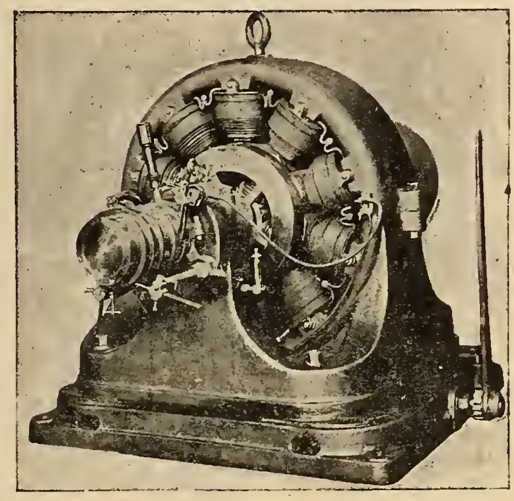

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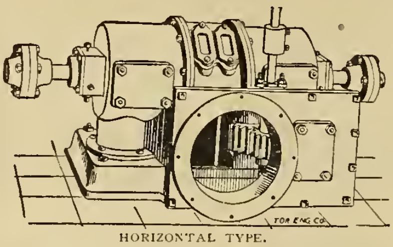

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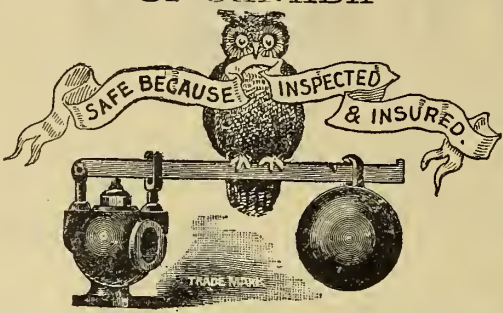

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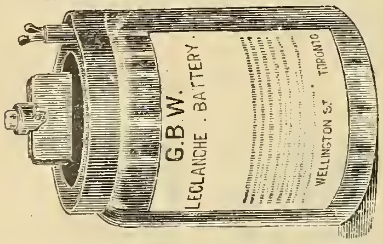
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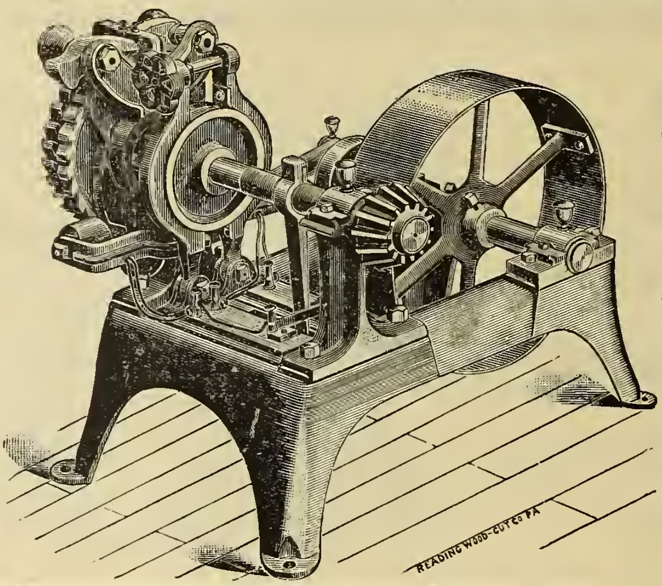

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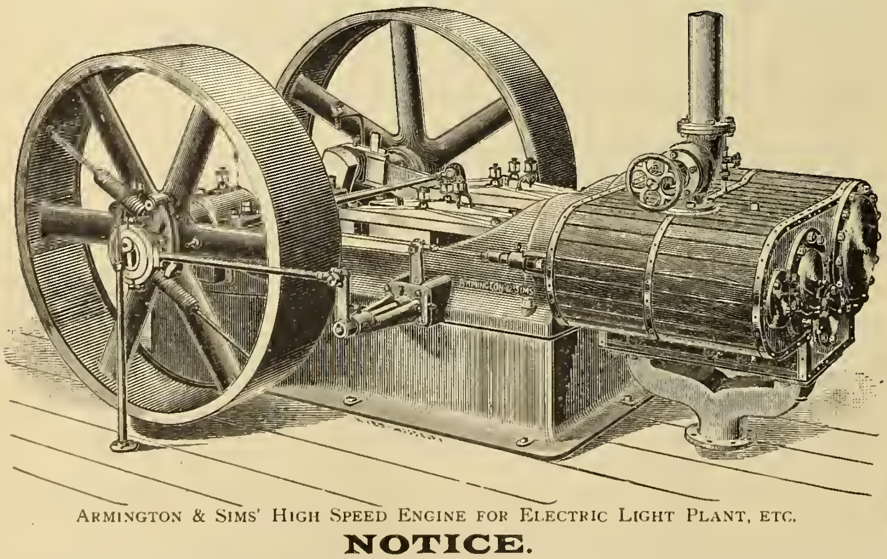

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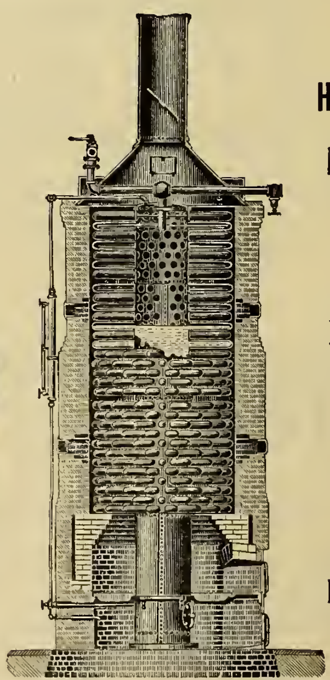

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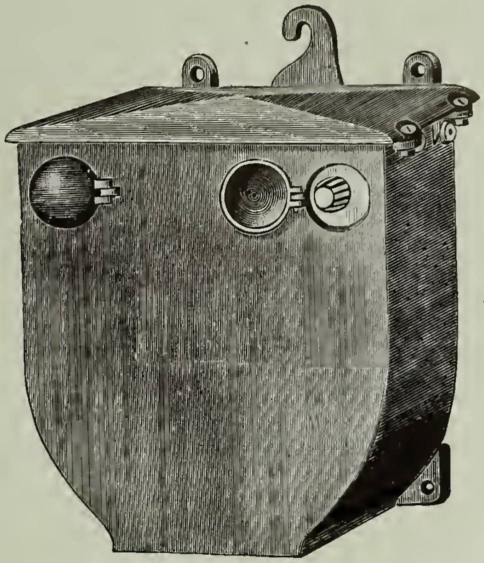

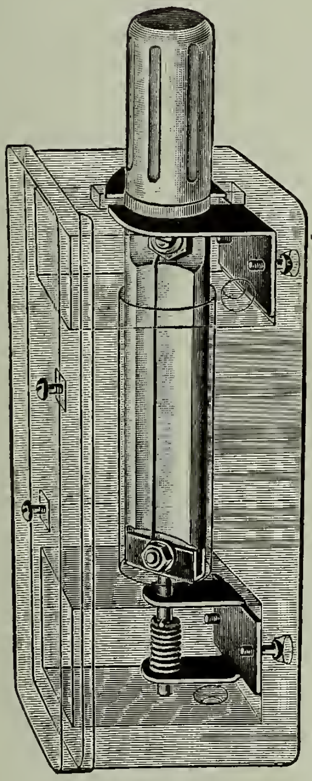

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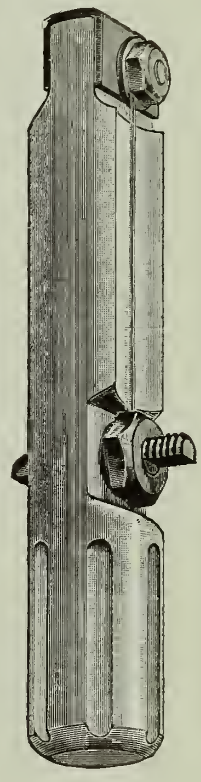

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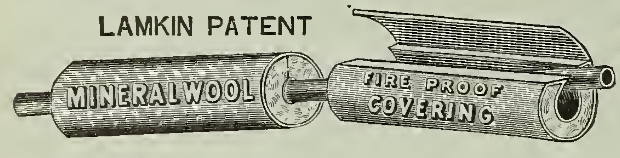

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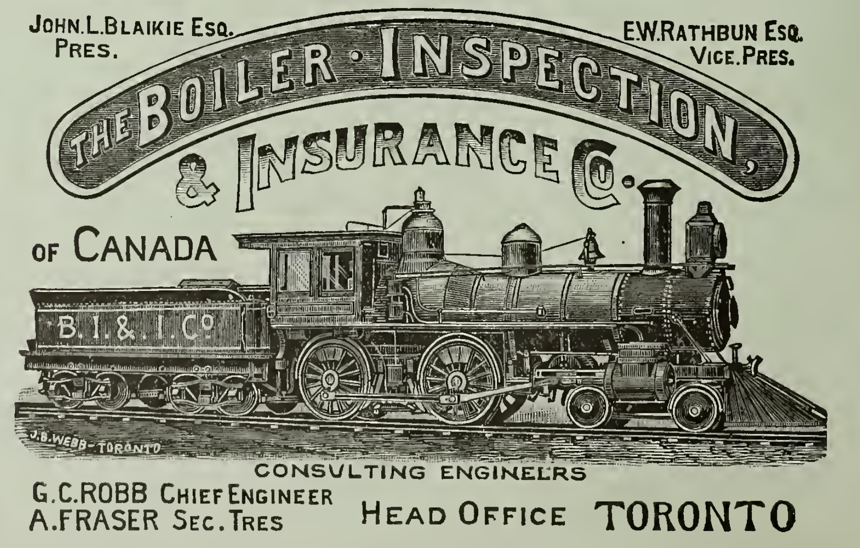

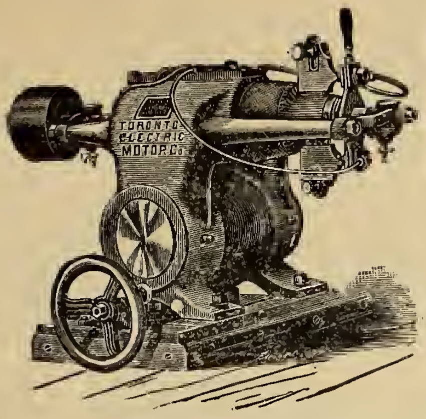

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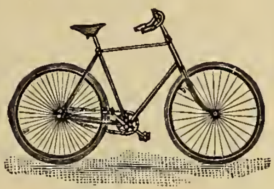

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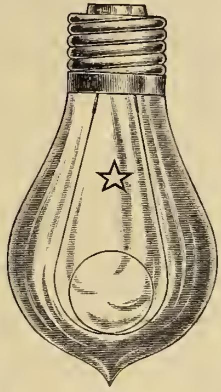

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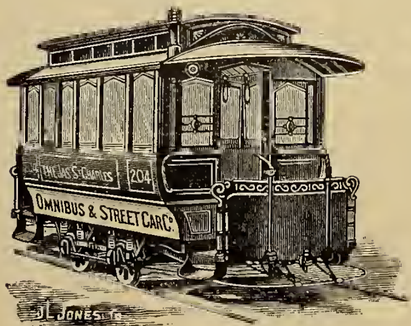

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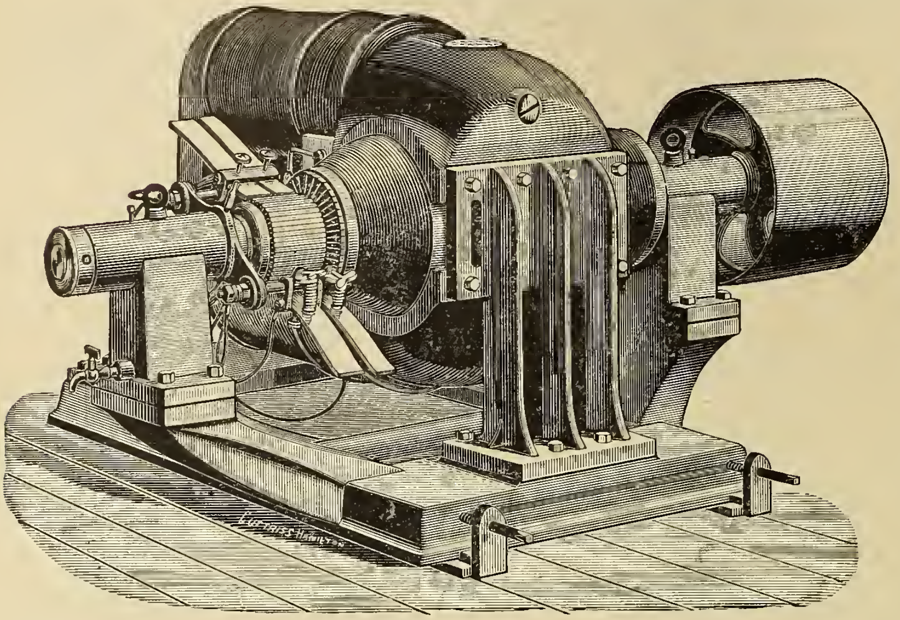

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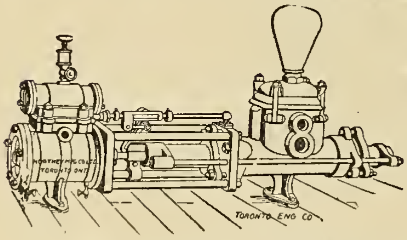

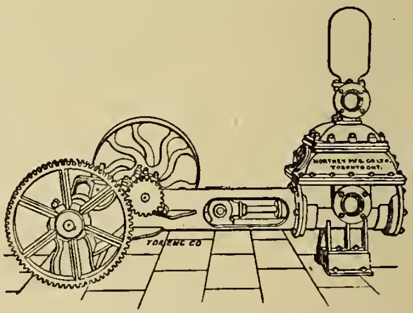

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Transformers, Lamps, Telephones, and Supplies of every description.

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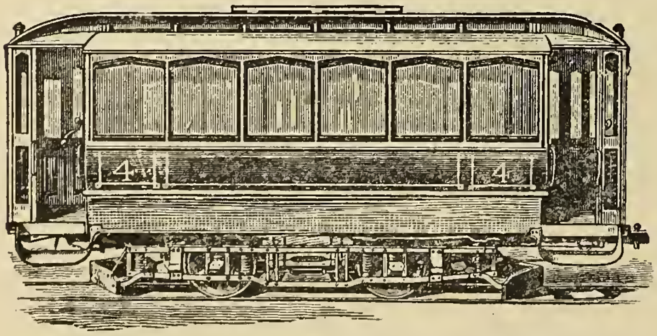

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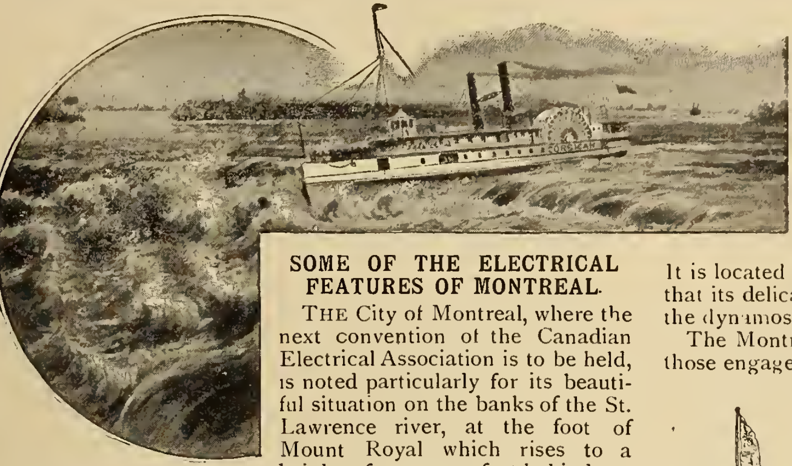
TORONTO ELECTRICAL WORKS Toronto

CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. IV. SEPTEMBER, 1894 No. 9.

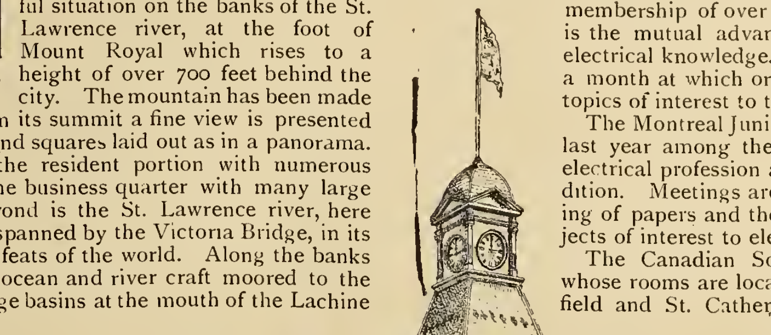


THE LACHINE RAPIDS

SOME OF THE ELECTRICAL FEATURES OF MONTREAL.

THE City of Montreal, where the next convention of the Canadian Electrical Association is to be held, is noted particularly for its beautiful situation on the banks of the St. Lawrence river, at the foot of Mount Royal which rises to a height of over 700 feet behind the city. The mountain has been made into a public park, and from its summit a fine view is presented of the city with its streets and squares laid out as in a panorama. Close to the mountain is the resident portion with numerous churches, further away is the business quarter with many large buildings and factories, beyond is the St. Lawrence river, here nearly two miles wide and spanned by the Victoria Bridge, in its day one of the engineering feats of the world. Along the banks of the river, are to be seen ocean and river craft moored to the wharves and also in the large basins at the mouth of the Lachine Canal. Beyond the city towards the south is a magnificent view over the surrounding plains which are dotted with villages and are broken here and there by hills, while in the distance loom up on clear days the Green Mountains of Vermont and the Adirondacks of New York. Up the river is a charming view of Lake St. Louis and the lower Ottawa Valley, which takes in towards the north a large portion of the Island of Montreal and the plains beyond with the Laurentian Mountains in the background.

Montreal is the commercial metropolis of the Dominion and enjoys great advantages as a distributing point from its location at the head of ocean navigation on the St. Lawrence river, which is here interrupted by the celebrated Lachine Rapids. The city contains much to interest the visitor, but the scope of this article only allows the following brief description of some of the features of interest to the electrical world.



MECHANICS' INSTITUTE BUILDING, MONTREAL.
(Meeting Place of the Canadian Electrical Association.)

McGill University, located on Sherbrooke street near the foot of the mountain, has a number of fine and imposing buildings, among which the workshops and the Physics and Engineering buildings contain much to interest the electrician. The latter buildings, as well as the equipments of their laboratories, were the gifts of W. C. Macdonald, Esq., whose generosity has given the University unexcelled facilities for imparting instruction in electrical engineering and the other branches of applied science. The equipments of the laboratories are very complete and have been pronounced by competent judges to be the best on the continent. The electrical engineering laboratories are located in the Engineering building and contain a well chosen collection of dynamos and motors of the principal types, besides a large variety of instruments for making practical tests and measurements. The lighting station for lighting the buildings is also located here and contains two 30 k. w. continuous current dynamos directly coupled to Willans engines, and also a storage battery plant. The Physics building, devoted to the study of physics, contains, in addition to the ordinary apparatus, some very delicate instruments for conducting research and making experiments. It is located about 400 yards from the Engineering building so that its delicate apparatus is beyond the disturbing influence of the dynamos and machinery there.

The Montreal Electric Club, organized two years ago among those engaged in the various branches of the electrical profession, is in a flourishing condition, having a membership of over 50. The object of the club is the mutual advancement of its members in electrical knowledge. Meetings are held twice a month at which original papers are read and topics of interest to the members discussed.

The Montreal Junior Electric Club was formed last year among the younger members of the electrical profession and is in a prosperous condition. Meetings are held weekly for the reading of papers and the discussion of various subjects of interest to electricians.

The Canadian Society of Civil Engineers, whose rooms are located at the corner of Mansfield and St. Catherine streets, includes in its membership, which numbers over 600, nearly every engineer in the Dominion. The rooms of the society are handsomely fitted up and include a reading room with the leading technical papers and a library of engineering books.

The Canadian Society of Stationary Engineers has two flourishing branches in the city, Montreal No. 1 and St. Laurent No. 2, which have a combined membership of over 200. The rooms of both are at 662½ Craig street and contain a well-assorted library of books and a valuable collection of models for the study of steam engineering.

The Bell Telephone Company's exchange in Montreal is one of the largest in America in proportion to the population of the city, numbering 5,700 subscribers who are served through four central offices. The main office is at the corner of St. Francois Xavier and Notre Dame streets, where the lines of 2,700 subscribers terminate. The Western District Exchange with about 1,700 subscribers is at the corner of St. Catherine and Mountain streets in a building owned by the company. The trunking wires to the Eastern Exchange and a portion of those to the Main Exchange are in underground conduits on St. Catherine street, of which there are about 1¾ miles laid. The Bell Company also has a large and well-equipped factory on Aqueduct street for the manufacture of telephone and electrical apparatus.

The Montreal Street Railway Company, which adopted electric traction two years ago, has over 65 miles of new track laid and over 110 motor cars running. The mileage of track and the equipment is being continually increased, as the system is far from completion and construction work is now going on. The power house is on William street and is to contain 6 cross-compound condensing Corliss engines rated at 600 H. P. each. At present, four only of the engines are installed. Three are belted to twelve 200 kilowatt Edison generators, and the fourth drives by one belt and one pulley two 300 kilowatt multipolar generators mounted on the same bed-plate. The pulley is on a shaft in alignment with and between the two armature shafts with which it is connected by friction clutches. The switchboard is built of hollow terra cotta bricks covered with adamantine plaster and afterwards enamelled, and presents a handsome appearance. Repair shops and commodious car barns are located at Hochelaga, and others are being built in different parts of the city.

The Montreal Park and Island Railway Company holds exclusive franchises covering almost every municipality on the Island of Montreal and has a line directly across the Island to Saul au Recollet and another to Outremont and Cote des Neiges. A branch to Lachine will soon be under way and next year the building of a line around the summit of Mount Royal is proposed. In building its lines the Company follows the practice of steam railways as far as possible and runs through an open country on a road-bed elevated from one to two feet, in preference to following the regular carriage roads and highways. Westinghouse and Royal equipments of the latest types are used. Royal generators driven by Corliss engines supply power. A special feature is that all the cars are despatched by telephone.

The Royal Electric Company has two lighting stations, one for commercial lighting and power and the other for street lighting, for which it has the contract from the city. The latter station is in a large one story brick and stone building on St. Ignace street. The electrical equipment consists of thirty 50 light T-H arc dynamos of Royal manufacture, driven from a counter shaft. Power is furnished by 3 cross and 1 tandem compound Brown engines, aggregating over 1500 H. P. On a platform near the centre of the dynamo room, is the switchboard from which the wires pass up to a tower on the roof of the building and thence are distributed in various directions. The station for commercial lighting is on the two lowest floors of the Company's new factory building on Queen Street. The steam plant is on the first floor and consists of a 1000 H.P. vertical compound condensing engine, besides three smaller horizontal engines. The electrical equipment occupies both floors and consists of Thomson alternators and power generators and T-H arc dynamos, all of Royal manufacture. A fire proof brick addition to this station is to be built and equipped with the most approved devices for the saving of labor, and made a model station in every respect. The Company's factory is in the original building on Wellington street and on the upper floors of the new building and is very completely equipped for the manufacture of electrical machinery.

The Temple Electric Company, which operates the Edison three-wire system, is fitting up a new station in a central location, as its business has outgrown the present quarters in the Temple Building on St. James street. The present plant has a capacity of about 5000 lights and is equipped with Edison and Reliance dynamos driven by Corliss engines. The Company has been hampered by lack of room, but in its new quarters will be able to largely increase its output.

The Citizens' Light and Power Company is erecting a new station on the banks of the Lachine Canal at St. Henri, to replace the present station, which is operated by water power. The equipment consists of a 750 light Edison alternator, 3 Edison, 2 T-H and 1 Wood arc dynamos to be driven by two 320 H. P. compound condensing Westinghouse engines, with Manning vertical boilers and mechanical draft.

The St. Jean Baptiste Electric Light Company's station is in a one story brick and stone building at 396 Montana street. The equipment is almost entirely new and consists of two slow-speed 2500 Westinghouse alternators and a 750 light T-H alternator driven from a counter shaft. Power is supplied by a 500 H. P. cross compound condensing Corliss engine and two small high-speed engines for use during light loads.

There are also a number of isolated plants and installations of more or less interest in the city, among which mention should be made of the lighting and storage battery plant at the Royal Victoria Hospital, which illustrates the best English practice, and the electrical plant for operating the Wellington Swing Bridge. The Montreal Fire Alarm Department has an interesting and finely equipped central office in the City Hall. The head office of the Canadian Pacific Railway Co.'s Telegraph is located in Montreal and the Great North Western Telegraph Co. has a large office in the city. In addition, the Anglo-American Telegraph Co. has a special cable office in Montreal.

In concluding, we desire to acknowledge our indebtedness to Messrs. F. E. Grafton & Sons for the cut of the Lachine Rapids which heads this article.

MONTREAL, ELECTRICALLY AND OTHERWISE, IS ONE OF THE MOST INTERESTING CITIES IN AMERICA. YOU WILL DERIVE PROFIT AND PLEASURE BY ATTENDING THE CONVENTION OF THE CANADIAN ELECTRICAL ASSOCIATION TO BE HELD THERE ON THE 19TH, 20TH AND 21ST INST.

CANADIAN ELECTRICAL ASSOCIATION.

Wednesday, Thursday aud Friday, the 19th, 20th and 21st inst., are the dates selected for the annual convention of the Canadian Electrical Association in Montreal. Following is the complete programme :—

WEDNESDAY, SEPT. 19TH.

11 A. M.—Opening of Convention ; Secretary-Treasurer's Report ; Reports of Committees ; General Business ; Paper on "The Application of Electricity for Medical and Kindred Purposes, from Light and Power Circuits," by Mr. W. B. Shaw, Montreal ; Paper on "Electrolysis," by Mr. J. A. Baylis, Bell Telephone Co., Toronto; Paper on "Alternating Current Motors," by Mr. L. M. Pinolet, Montreal.

5 P. M.—Trip to Lachine and return via Lachine Rapids.

THURSDAY, SEPT. 20TH.

9:30 A. M. (SHARP).—Meet at Mechanics' Institute to visit McGill University by invitation of the Faculty of Applied Science and Prof. Chas. A. Carus-Wilson, of the Electrical Department, inspect the electrical laboratories and witness a practical test on a transformer of apparatus for the measurement of alternating current power.

11 A. M.—Meet in Convention at Mechanics' Institute ; Paper on "Electric Brakes," by Mr. Elmer A. Sperry, of Cleveland, Ohio ; Paper on "A Method of Distribution with Equalization of Potential Difference," by Mr. D. H. Keeley, of the Government Telegraph Service, Ottawa ; Paper on "The Possibility of Securing Better Regulation at Central Light and Power Stations by means of Fly Wheel Accumulators of Improved Construction," by Mr. John Galt, C.E. and M.E., Toronto ; Paper by Mr. John Langton, Toronto.

4:30 P. M.—Special excursion on Montreal Park and Island Electric Railway to Back River. Dinner at Peliquin's Hotel, Back River, at 6 p. m.

FRIDAY, SEPT. 21ST.

10 A. M.—Paper on "Municipal Electric Lighting," by Mr. E. Carl Breithaupt, of Berlin, Ont.; Paper on "Telephone Cables, their Construction and Maintenance," by Mr. F. J. Schwartz, Bell Telephone Co., Montreal ; Paper by Mr. T. R. Rosebrugh, Lecturer in Electricity, School of Practical Science, Toronto ; Election of Officers ; Unfinished Business.

2 P. M.—By courtesy of Eugene F. Phillips Electrical Works, drive to Mount Royal Park, including a visit to Montreal Street Railway Power House.

5 p.m.—Luncheon at the St. George Snowshoe Club House by invitation and courtesy of The Packard Lamp Co.

The Executive regret that the early date fixed by the railways for their annual fall excursion has rendered it impossible to make the Convention coincide therewith, and that in consequence no reduction in railway rates can be secured beyond that ordinarily given to the purchaser of a return ticket.

Messrs. Ahearn & Soper, of Ottawa, have extended to members of the Association a kind invitation to visit Ottawa at the close of the convention. Arrangements have been made for their entertainment and to show them the many interesting electrical and other features of the city. Delegates from west of Ottawa, by C.P.R. line, have the privilege of going or returning via Ottawa, and of stopping off at that city. Leaving Montreal in the morning they would arrive at Ottawa at noon, and leave at 9 p.m., arriving in Toronto the following morning.

THE BELL TELEPHONE COMPANY'S NEW SWITCHBOARD.

NEARLY a year ago, in connection with a description of the Bell Telephone Company's factory in Montreal, mention was made in the ELECTRICAL NEWS of the new switchboard then under construction at this factory for the Toronto Exchange. The finished material for this switchboard was shipped to Toronto a couple of months ago, since which twenty-five workmen have been engaged day and night in erecting into proper position the multitude of parts of which the finished structure will be composed.

The board has an iron frame which will be covered with mahogany. The wires are brought up from underground in the basement of the building, run under a false flooring to the back of the switchboard, and there connected on to drops, jacks, etc. The jacks number about 80,000. A one-half horse-power motor generator is to be employed for ringing purposes instead of a gas engine, and a storage instead of a gravity battery for transmitters, thus doing away with several hundred cells of battery.

When a call comes from a subscriber, and the armature falls outward, it throws up an aluminum cover revealing the subscriber's number. When the plug is inserted by the operator, the cover automatically falls. To each section of the board is connected an incandescent lamp, which glows so long as any drop is down. In short every improvement which was considered to be of value has been incorporated into the construction of this switchboard, which, when complete, will be the model telephone switchboard of America for a time at least, until the march of improvement shall have caused it to be superseded by others of still more modern design. Three or four months will yet be required to complete its erection. When complete, tested and in satisfactory working order, the operators will be removed from their old quarters in the Mail building to the new Exchange on Temperance street. Following their removal will come the taking down of the mass of overhead cables on Bay street.

INDIFFERENCE TO BOILER FIRING AND MANAGEMENT.*

OBSERVATIONS extending over a period of a quarter of a century in a practical and professional way have presented opportunities to note, in the greater number of manufacturing establishments, a continuous decline in the grade of service of those in positions of firemen and boiler room managers, this corps of operatives seeming at least, to have remained in *statu quo*. The evil has become so glaring and the results so palpably fraught with disaster, destruction and waste, as to warrant an effort to call the attention of those who desire to progress to the false and inconsistent position they occupy by permitting such a narrow policy in management, so widely at variance with true economy, ignoring directly that the better intelligence renders the more valuable, and hence, more profitable service.

It goes without saying, that, during the past ten years concentration of efforts by scientists and eminent mechanics looking to the more perfect development of the steam engine in its various types, has produced results which challenge the admiration of the most critical in this line of thought.

Within the same period, from every source, there has been a multitude of features in the form of designs and novel application of boilers, all converging to the important factors of increased economy, safety and efficiency. In the engine sphere, condensing, compound and triple expansion engines, with or without jackets; in brief, seemingly all the necessary refinements have received, and are receiving close attention. In the boiler domain there has been, also the evolution from the plain cylinder type to tubular, and from that through the multifarious forms of water tubes, each striving for a superior degree of excellence. Combining these forces, viz., the boiler and the engine, the amount of research and practical application that have been, and are being applied for efficiency and economy, are such as to be almost incalculable. A retrospect of the past, viewed in the light of present results, shows that these efforts have been of an exceedingly fruitful character.

The development has carried with it the imperative advancement of those in charge of engine management to such an extent as to create almost anew this body of men. Such an intellectual advancement in the department of mechanics, we believe, is without precedent, and in every sense challenges universal admiration from every quarter. Notwithstanding these favorable features, we are constrained to say that all this is somewhat like the play of Hamlet with Hamlet left out; or in other words, we are radically defective at the very threshold of this field, by reason of relegating the firing of boilers to the most ignorant of operatives; or, to put it in a plain way, there seems to be an almost unanimous idea that anyone who can shovel and throw fuel is good enough for a fireman. Close observation and contact for a period of years with numerous plants of varied character increases the conviction upon this point. Recognizing, as we all do, that the furnace of the boiler is the prime feature and great initial point from which is the source of power, does it not follow that, if economy and efficiency are deserving of efforts in the advanced stages, as has already been pointed out, this is the very point that should be treated with every consideration of intelligence? Should not the fuel, furnace and boiler receive the thoughtful attention that the engine receives from the careful engineer? I think this will be accepted by every one interested in advanced ideas. No one, I think, will question the fact of the importance of the initial point of the boiler and its furnace, and that, upon its mismanagement, the efforts of refinement are rendered, in many cases, completely void. It would seem so simple that argument would be unnecessary, were it not that, on every hand, the matter is entirely ignored, resulting in waste and destruction. We would ask: Are not the efforts of the best furnace designers completely set at naught often by reason of the manner in which they are operated? Is it not a glaring fact that in all cities where smoke abatement has been, and is being attempted, the great stumbling block is the low grade of intelligence and difference of the operatives?

In looking up this subject from a mechanical and engineering standpoint, we are fully alive to all the requirements to give complete combustion and thorough distribution of heat units; proportion of grate area and openings, proper amount of air, conduction of the heated gases, are all carefully considered. When all is completed, we have had the wonderful spectacle of these conditions being turned over to the simple treatment of ram jam shovelling and slice bar operations. I claim that the fireman should know, at least, the elements of combustion, the importance of the proper management of fires to produce the greatest results with the least expenditure of fuel. The intelligent engineer keeps this constantly in view as to steam economy; the valves, etc., receive his unremitting attention, unless he can properly be placed upon the same plane as the fireman that shovels without intelligence or judgment.

Now, it may be said that this is being greatly overcome by application of mechanical stokers, a point that is frequently (and I believe, without thinking) claimed by those interested in placing stokers. This is a great mistake, well known by those conducting tests, results always being superior with the greater intelligence of the operator of the machine.

This deplorable and absurd state of affairs is doubly aggravated by, not simply indifference, but actual encouragement, based upon the idea that anyone can shovel or throw in; or perhaps it is the idea of—they put it in the slot, and we do the rest. Does it ever occur to those proprietors, or the superintendents of manufacturing establishments, that while they are straining at gnats in the refinement of every application in the various departments looking to more economic results, right upon the threshold, they are swallowing a camel with the greatest ease?

Within the past few years, in every community where cleanliness, taste and good health are considered, there has come forth a crying appeal to the authorities to lessen the great evil of smoke in the atmosphere. In response to this, inventive genius has promptly come forward. The multitude of devices that have been perfected and put in operation furnishes ample testimony to this fact. Many of these when properly operated, accomplish satisfactory results in smoke abatement, but no inventor has ever had the temerity to label his machine, "No skilled fireman required." Per contra, it is well known that the most intelligent fireman produces the best results, and it is also an undeniable fact that the best results are set at naught by incompetent operating. The writer has been brought in contact with large fields of boiler practice, and in many cases, aside from other disqualifications, the firemen were unable to speak or understand a word of the English language. It may be said, as I have heard it said, that these men are not paid to think, but to do. Well they do do. They will do up a coal pile, furnace and boiler with alarming rapidity. I say alarming to those whose views are broad enough to consider the initial and important points. On the other hand, it is a lamentable fact that there are a great number of persons in official positions, as superintendents and proprietors of establishments, who seem to be utterly incapable, or unwilling, to note the importance of the necessity for a higher grade of labor in the firing and management of boilers.

One of the most surprising features in connection with this state of affairs is the tendency of those to place boilers, claiming, among their numerous merits, that of less attention required than others, precisely on the old exploded idea applied to engines, "No skilled engineer required." I have now before me a letter from a boiler representative who claims that his boiler will give the utmost satisfaction with one half the attention that others receive.

What is greatly needed at present is to lay aside the idea that anyone is good enough to fire and manage boilers. When you engage a man for your office, do you not require that he shall possess some qualification for the position? And if aptness is shown, do you not show appreciation by advancement to a higher plane, the interest being mutual? Why not apply this to the selection of firemen? As it now stands, we cannot but exclaim, "Strange, what a difference there should be 'twixt tweedle dum and tweedle dee!"

There are a great many plants in operation where, by incompetency in this line, the steam efficiency is greatly lessened, furnaces and boilers working in neglected conditions, and the community begrimed with volumes of unnecessary smoke; and in addition to these evils, is that of jeopardizing lives and property. Unless this matter is considered, and such action taken as will improve this corps of operatives, it would seem absurd to be continually reaching and extending into the higher refinements of steam engineering, when such simple and important features are ignored at the threshold.

Under these conditions, does not the pertinent question present itself to the employer—are we not occupying a false position by this seeming indifference? Do we not retard the development of a class of labor which by recognition, by an appreciation that some skill and judgment are required, would be animated by the smallest spark of ambition to qualify for advanced position? Is not this condition of affairs a gross inconsistency, nay, a mockery, in the face of the query put by those guilty of this indifference—why can we not get better men than this? In reply to that, would say, simply, it is not sought on your part. Just as long as this class of operatives are looked upon as mere shovelers, throwers of coal and carriers of water, ignorance, with all its attendant waste, destruction of property and general demoralization, will be prominent in the boiler department.

As a fitting close to this, it would be proper to ask what degree of intelligence or knowledge would qualify one to fire boilers.

First. That the fires should be maintained with uniformity, and that no openings, in the form of bare places, show upon the bars to permit the cold air to pass through.

Second. The judgment that will enable him, by a glance at the ash-pit, to know at once, to a great extent, the condition of the fires.

Third. He should know something of the various fittings of the boilers, such as valves, etc., and the details of the furnaces.

Fourth. But not least, an ambition to grasp the details, so as to qualify him for a still higher plane, which would certainly follow, provided there was judgment enough in the superior to note such details.

Sufficient, we think, has been said to convince the most obtuse mind that the indiscriminate employment of labor for this purpose is a crying evil, and some consideration given to the claims here made, that simply because one can shovel and throw, it does not follow that he is qualified to fire and have charge of steam boilers.

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* By D. Ashworth, before the Engineer's Society of Pennsylvania, Nov. 21, 1893.

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Correspondence is invited upon all topics coming legitimately within the scope of this journal

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Information regarding examinations will be furnished on application to any member of the Board.

PLACE AND TIME: MONTREAL, SEPTEMBER 19TH, 20TH AND 21ST, 1894.

IN electric railway construction, equipment and management Canada is undoubtedly right up to date. In some particulars we are in advance of the United States, where the electric railway has had such an astonishing development. It is very gratifying to Canadians to observe the wide-awake manner in which the managers of electric street railways in our leading Canadian cities keep in touch with improvements, and the readiness with which such improvements as are proved to be valuable are adopted.

WITH the object of saving time, the principals of many business establishments are in the habit of instructing a subordinate to ring up on the telephone the managers of other business concerns with whom they desire to hold converse. When the manager who is thus called up, responds, he is asked by the subordinate to wait until the person who desires to speak with him gets through with the matter which at the moment may be engaging his attention. This "wait" may last one minute or five, according to circumstances. Thus the man who wants to do the talking effects a saving of time at the expense of the one at the other end of the line. If, however, this practice should grow, he will in due time find himself in the position of respondent, and will ultimately not succeed in saving any time at all.

MANUFACTURERS of steam engines and other high-class machinery in the present day must be prepared to furnish machines which will not only operate economically and in every respect satisfactorily, but which will also be attractive in design and finish. The purchaser of a steam plant wants one that will do his work in the cheapest and most efficient manner and will also by its beauty of design and finish awaken the admiration of visitors to his establishment. Many instances could be cited in which orders for machinery have been secured by representatives of Ontario manufactories right at the door of the local manufacturer in some of the other provinces, simply because the latter's goods were inferior in point of finish. It is noticeable that of late some of the more wide-awake machinery makers in the other provinces have become alive to this requirement of their business, and by complying therewith, have succeeded in retaining their home trade and are selling their machinery in Ontario in competition with the manufacturers of this province. In the manufacture of engines a very noticeable improvement is taking place in the maritime provinces, and from that quarter increased competition is likely to come westward in the near future. It is contended by the manufacturers down by the sea that more favorable rates of freight are given on products of western factories shipped to the east than on eastern shipments to Ontario. If such be the case, the discrimination should be done away with, and every facility given for free interchange of business between the different parts of the Dominion. If this were done much of the money which now goes across the line from Canadians living alongside the border of the United States would be diverted to the pockets of Canadian manufacturers.

It is not easy to see that a sufficiently useful purpose is to be served by the new Electric Light Inspection Act, the full text of which was published in the August number of the ELECTRICAL NEWS. It is not too much to expect that an enactment of this character should have a clearly defined aim and grasp completely whatever it does aim at. If this act had been called an Electric Meter Inspection Act, its purpose would have been more comprehensible, though its utility might have been equally doubtful. But assuming that it is advisable to secure by statute the right of purchasers to have their current metered and, that being the case, that for the protection of both purchasers and contractors the meters should be placed beyond suspicion by government inspection, and that the machinery for such inspection must consequently be provided by law, why was not the scope of the act confined to this object? The main portion of the act is devoted to this, is definite and detailed and hence respectable, though as a matter of opinion it may be considered unnecessary. But outside of the meter sections the act wanders aimlessly and inadequately over quite a number of questions, some of which if treated at all, would properly require an act to themselves. In one instance at least it is positively mischievous, where in section 7 it defines the minimum permissible ground at 5,000 ohms, and imperatively enacts that the contractor shall forthwith cut off such grounded premises, under the penalty prescribed in section 9 of a fine of $20 a day. This is a wonderful simplification of electrical formulae; whether the pressure be 50 volts or 250 volts, whether the premises contain 1 lamp or 1,000 lamps, yards or miles of wire, the exact danger point in all cases is a ground of 5,000 ohms. Put up ($20), or shut up. Most people are under the impression that this point is above all a matter for skilled judgment depending entirely upon the conditions; but they are wrong—by Act of Parliament. The statute is positive. Just at the very last it weakens for a moment and seems to have a glimmering that the illumination, which is the object of electric lighting, is not entirely gauged by even an inspected meter; but it most ungenerously throws the burden upon the Governor in Council by enacting in the last section that he "may establish rules and regulations for the testing of electric light lamps for illuminating power". The stamp of good legislation is that it should be so definite in its grasp of the main issues, and so devoid of any dependence upon the minor points of controversy, as to aid in its own enforcement whilst avoiding any interference by unnecessary definition with progress by natural development. But it cannot be said that this act answers to such a description, indeed it is hardly too much to say that it is throughout fussy, and in parts at least, futile.

SOME of our neighbors in the State of New York have taken alarm at the scope of the various plans on foot to utilize the water power of Niagara Falls, and at the unlimited character of the licenses already granted to divert water from the Falls for this purpose. A committee of the constitutional convention of the State of New York now sitting, has presented a report dealing with this matter, which is being opposed by representatives of the power companies. It is to be hoped that the subject will be thoroughly thrashed out. Certainly on investigation it does seem as if there were some grounds for the action which has been taken, and a doubt whether we have not gone a little too fast and too far in granting franchises. It is difficult to get reliable figures on the flow of water over Niagara Falls, but taking those given in the Encyclopediæ Britannica 18,000,000 cubic feet per minute, with a fall of 164 feet on the American side and 150 feet on the Canadian side—the gross power would be a little more than 5,250,000 H. P. With such an enormous power to draw from it would seem that we might cut and come again without risk of any appreciable effect upon the natural beauty of the Falls. But on examining the franchises granted a little in detail it appears that if they are availed of to the full extent of the projectors' anticipations, that there would result a serious impairment of the volume of water now passing over the Falls. The present tunnel on the American side is only 100,000 H. P. capacity, but the full projected power on that side is stated to be 500,000 H. P., which at the present available head of 140 ft., would require about 200,000,000 cubic feet of water gross. On the Canadian side, by agreement approved by the Ontario legislature, the power company has the right to take water for a power station occupying a tract of land not to exceed 100 ft. by 1200 ft. The present station on the American side is of 50,000 H. P. capacity, measures 68 by 200 ft., therefore the limit of the Canadian concession would be about 300,000 H. P., or about 1,200,000 cubic ft. of water. These two principal undertakings would therefore amount to 3,200,000 cubic feet, which the electric railway on this side, the old hydraulic canal on the other side, and existing private and town rights on both sides, would easily swell to 3,600,000 cubic ft., or 20% of the natural flow as given in the Encyclopediæ Britannica. One fifth reduction in the volume of Niagara Falls, would involve a ruin of their natural beauty, which would be a disgrace to us as one of the custodian nations of this wonder of the world. Such a catastrophe is only a possibility, and a remote possibility. Unless further powers are granted, on the Canadian side, the concession is probably limited to less than the amount estimated above, by the provision in the agreement that the water shall be led off by the natural channel between Cedar Island and the mainland. But even the possibility of such a catastrophe in the far future, fully justifies the action which has been taken in New York. No shadow of excuse could be urged for destroying Niagara Falls for the enrichment of a few capitalists and a locality. We are far from the time when any pressure of population on our national resources could justify such utilitarianism.

EXPERIENCE has pretty well shown by this time that any new art which serves some useful purpose, is, broadly speaking, a friend rather than a foe to its apparent rivals in the same field. By cheapening or simplifying the object to be attained, and by familiarizing the general public with the advantages to be gained by its use, the new method on the whole increases the total demand by a greater amount than the share which falls to itself. Of course locally and in individual cases the rival may suffer, though even where this would seem an obvious consequence, it sometimes results quite otherwise, as in the case of the increased earnings of those New York street railways which were apparently doomed to ruin by being roofed throughout their whole length by the elevated roads. As a whole the increased recognition of the value of the idea means increased business to all concerned. As already referred to, rapid transit has greatly increased the total of city and suburban travel. The electric light gave people a new standard of illumination, and a new idea of the value of abundant light, with the result that the total use of light has been largely increased. And we should be surprised if the general use of local and long distance telephones, by introducing conditions and habits of business which made full and rapid communication a necessity, did not react to the benefit of telegraphs and all other methods of correspondence. We are apparently on the eve of being furnished with another instance of the same principle. Gas engines were just coming into use commercially some years ago when the electric motor started on its astonishing career. It supplied the demand for small powers better than the somewhat crude gas engine of that day and secured the field to itself. But it did more than secure the field, it extended it, and the additional business thus brought into sight stimulated the gas engine manufacturers to new exertions, until now a great variety of gas motors are in the market of apparently simplified mechanism and improved economy. The average gas consumption of motors is stated at 26½ cubic feet of lighting gas per effective horse-power hour; and this is the actual consumption of one plant consisting of two 60 H.P., one 30 H.P. and one 8 H. P. gas motors. If anything like these figures can be relied upon for small motors in ordinary use the gas motor is already far on its way as a competitor to the electric motor. With gas at $1.00 per 1000 and a consumption of 26½ cu. ft., the gas motor at 2⅔ cents per H. P. hour, already beats the electric motor in its expense for power. If it can match it in first cost and ability to stand lack of care and attendance, the electric motor will have to reckon with a formidable rival.

One paradoxical result of efficient and reliable gas motors is that in many cases the most economical illumination will be electric light from dynamos driven by gas motors. Taking as a basis gas for both power and lighting at $1.00 per 1000, gas motor consumption 26½ cu. ft. per effective H. P. hour, and the usual assumption that a 5 foot gas burner equals in illuminating power a 16 C. P. incandescent lamp; we have a 5 foot gas jet costing ½ cent per hour, and an incandescent lamp costing 6-10 cents per hour (central station selling rates), to compare with a gas motor driven by private electric plant. Such a plant including the loss in dynamo and wiring should certainly give 11 16 C. P. lamps per effective horse power of gas motor, the latter costing 2⅔ cents per horse power hour for power. This would be an expense for power alone of ¼ cent per lamp per hour: half the cost of gas and less than half the cost of central station rates. To this expense for power must be added the expense for lamp renewals, attendance, insurance, taxes, interest on investment and a liberal allowance for depreciation. For the last four items, in a small plant, it would only be properly conservative to allow 25% per annum on the total investment; but even with this high rate the total cost of making light will figure out to less than the buying cost in a plant where the average hours burning per lamp per diem are of any length. The determining factor is of course the average time per day the lamps are in use throughout the year.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of the various Associations are requested to forward to us matter for publication in this Department not later than the 20th of each month.

THE ANNUAL CONVENTION.

As this issue of the ELECTRICAL NEWS leaves the press the delegates from the various associations composing the Canadian Association of Stationary Engineers are about to assemble in annual convention at Toronto. The sessions will extend over four days. Many matters of importance to the welfare of the Association will come up for consideration at this meeting. Papers will be read as follows: "Steam Jackets" by Mr. John Murphy, of Montreal; "Steam Separation" by Mr. Granberg, Montreal; "The Inspirator" by Mr. A. E. Edkins, Toronto; "Steam Heating," by Mr. A. M. Wickens, Toronto. The fifth annual banquet of the Executive Council Convention will be held at the Palmer House on the evening of the 5th inst.

MONTREAL ASSOCIATION NO. 1.

The installation of officers of Montreal No 1, C. A. S. E., took place on the 2nd of August. The following are the names: past president, J. G. Robinson; president, John J. York; vice president, T. Martin; 2nd vice president, A. Thompson; treasurer, T. Ryan; secretary, E. O. Granberg; financial secretary, J. Jones; corresponding secretary, A. W. Brown, 477 St. James street, conductor, P. Mooney; doorkeeper, J. Dooner.

The 5th annual convention takes place at Toronto on Sept. 4th. A special car has been engaged, and the following delegates will attend: J. J. Robinson, H. Nuttal, J. Murphy. Also the following members of the Executive Board: president, J. Hunt; secretary, J. J. York; chairman, T. Ryan, and district deputy, J. Hardestein. The Winnipeg delegates will meet those of Montreal No 1 here, and delegates from Ottawa, Kingston, Brockville and Belleville will be taken up on the way.

E. O. GRANBERG,
Secretary.

HAMILTON ASSOCIATION, NO 2.

Editor ELECTRICAL NEWS.

SIR,—The two last meetings of this Branch were of a very interesting character, the discussions being, however, of a somewhat private nature. At our last meeting we appointed as our delegates to the convention to be held in Toronto, Bros. Duncan, Robertson and E. Johnson.

As far as we can see this year's convention promises to be a very important one, and one that should tell on the welfare of the order at large. The representatives will have a good chance to make the influence of this convention felt far into the future history of the C. A. S. E., and it is the earnest wish of this Branch that such will be the case.

WM. NORRIS, Cor. Secretary.

ST. LAURENT NO. 2.

St. Laurent Branch, No. 2, Montreal, have recently elected officers as follows: R. Drouin, president; P. Marchand, 1st vice-president; Joseph R. Guillemette, 2nd vice-president; F. Latour, recording secretary; Francois Denis, financial secretary; W. Gendron, treasurer; J. J. Joly, conductor.

We learn that this Association is in a thriving condition, having added about twenty new members during the past twelve months.

KINCARDINE ASSOCIATION NO. 12.

Editor ELECTRICAL NEWS.

SIR,—The following have been elected officers of this Association: president, Jos. H. Walker; vice-president, John H. Cress; secretary, A. Scott; treasurer, D. Bennett; conductor, Percy C. Walker; doorkeeper, Jas Carroll; trustees, J. H. Walker, Percy Ashton and G. H. Lighthall; delegate to convention, J. H. Walker.

Owing to a number of our members having been absent, we have not been able to hold our meetings regularly, but at our last meeting we had a very interesting and instructive time, and we trust it was only a commencement, and that as the evenings lengthen they will be better attended. At our last meeting we had two initiations and one proposition for membership.

ANDREW SCOTT,
Rec. Secretary.

QUESTIONS AND ANSWERS.

"Young Beginner," Spadina Avenue, Toronto, writes: "I should be much obliged to you if you could answer the following questions in your next issue of the September CANADIAN ELECTRICAL NEWS. (1) Will a slide valve steam cylinder do for the purpose of compressing air, and will compressed air work a steam engine in the same manner as steam? (2) What kind of brakes are taking the lead now? Are there any, which, instead of acting by friction, so as to cause heat, conserve the energy so that it can be used to start the same object, thereby affecting a saving in overcoming the resistance of the object to be moved?

ANSWER.—(1) Slide valve engine will work with compressed air, or could be used as an air compressor, though of course motors and compressors specially made for the purpose are best. Compressors get warm and require water jacketing. Motor gives best economy with compressed air heated previous to admission. (2) Many brakes for storing power have been invented but none have come into general use; braking by friction on wheels is practically universal.

MOONLIGHT SCHEDULE FOR SEPTEMBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	
1......	P. M. 7.20	A. M. 4.30	9.10
2......	" 7.20	" 4.30	9.10
3......	" 7.30	" 4.30	9.00
4......	" 7 50	" 4.30	8.40
5......	" 8.50	" 4.30	7.40
6......	" 9.50	" 4.30	6.40
7......	" 10.40	" 4.30	5.50
8	" 11.10	" 4.30	5.20
9......	" 11.40	" 4.30	4.50
10......	....	" 4.40	4.00
11......	A. M. 12.40	....	
12......	" 1.40	" 4.40	3.00
13......	No light.	No light.	....
14......	No light.	No light.	....
15......	No light.	No light.	....
16......	No light.	No light.	....
17......	P. M. 6.40	P. M. 9.20	2.40
18......	" 6.40	" 10.00	3.20
19......	" 6.40	" 10.40	4.00
20	" 6.40	" 11.20	4.40
21......	" 6.40	A. M. 12.10	5.30
22......	" 6.40	" 12.50	6.10
23......	" 6.40	" 2.00	7.20
24......	" 6.40	" 3.10	8.30
25......	" 6.40	" 4.10	9.30
26......	" 6.30	" 4.50	10.20
27......	" 6.30	" 5.00	10.30
28......	" 6.30	" 5.00	10.30
29......	" 6.30	" 5.00	10.30
30......	" 6.30	" 5.00	10.30
		Total,	159.20

BE SURE THAT YOUR LIST OF ENGAGEMENTS FOR SEPTEMBER INCLUDES THE CONVENTION IN MONTREAL OF THE CANADIAN ELECTRICAL ASSOCIATION.

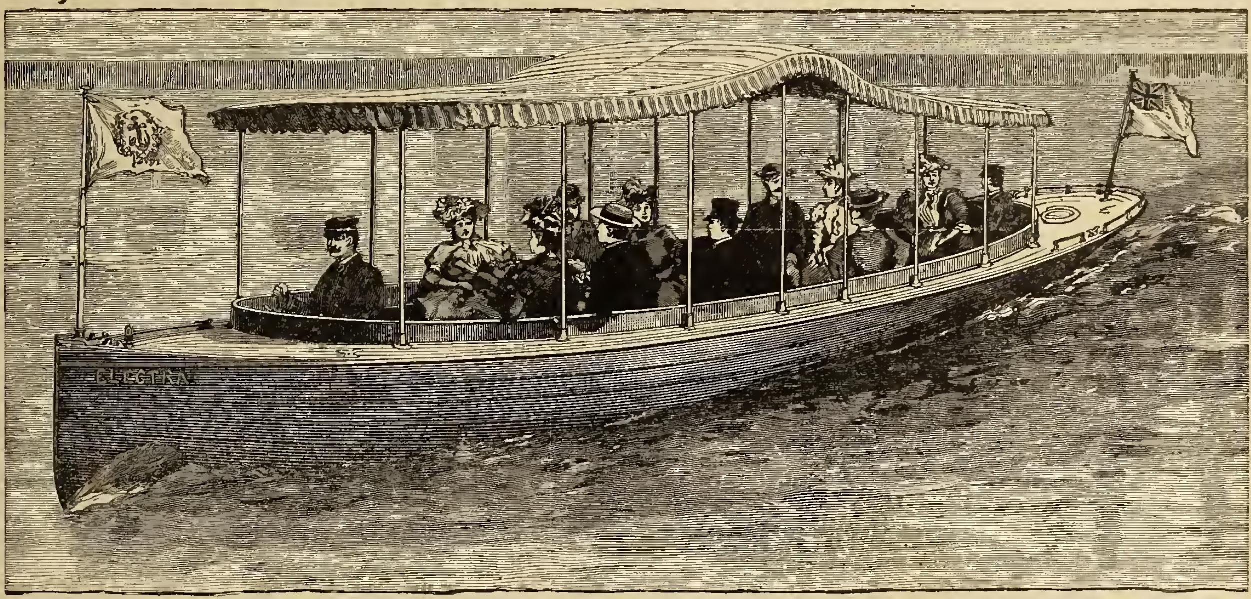
HIS EXCELLENCY THE EARL OF ABERDEEN'S ELECTRIC LAUNCH.

BELOW is a cut of His Excellency the Earl of Aberdeen's electric launch. The launch was purchased and refitted by Mr. O. Higman, electrical engineer, of Ottawa, from the Electric Launch and Navigation Company, the concessionaires of the electric launch privilege at the World's Columbian Exposition in Chicago. The boat is 35 feet 10 inches over all in length, and 31 feet 6 inches on the water line. The beam is 6 feet 2½ inches, and the draught 27 inches. The lines are as near perfection as they well can be, and at whatever rate the launch runs there is practically no wake, so that the wash on the shore, of even very narrow waterways, is of no consequence.

The hull is constructed of white oak frame, with white cedar planking. The inner panelling, decks and other parts, are finished in mahogany. All the woodwork is finished in its natural color, thus giving a very rich appearance. The launch has a seating capacity for about 30 people.

The motor is nominally of four horse power, and is placed low down in the centre of the boat. The motor was designed and made especially for this use by the General Electric Company. The storage batteries are placed around the sides of the boat, and under the seats, entirely out of sight. There are 56 cells of the Consolidated Electric Storage Company's type, of 150 ampere hours capacity. These cells can be arranged in three groups of 22 cells in series, or in two groups of 33 cells in series. The motor is coupled direct to the propeller shaft. By a combination of direct coupling and thrust bearing, all gearing and loss of power, as well as unnecessary noise and jar, are done away with.

The launch is at present charged from the Ottawa Electric Company's 250 volt power circuit, a rheostat being used to reduce the current to about 40 amperes at 90 volts. From six to seven hours time is required to charge the batteries at this rate, and when charged are good for a run of 10 hours at the normal speed of seven miles an hour. The control is by means of a small lever switch at one side of the steering wheel, which is located in the forward part of the boat. This lever allows of four speeds forward and two backward. Although the normal speed, as previously stated, is seven miles an hour; the boat has a reserve speed of from 9 to 10 miles an hour.



HIS EXCELLENCY THE EARL OF ABERDEEN'S ELECTRIC LAUNCH.

SPARKS.

Mr. R. Potter has been given the franchise for electric street lighting at Tweed, Ont.

The purchase of an electric light plant is being considered by the ratepayers of Winchester, Ont.

An incandescent electric light plant will be placed in the steamer "C. H. Merritt" at Kingston next winter.

The Bell Telephone Company have recently constructed a metallic circuit from Windsor to Amherstburg, Ont.

A by-law providing for the establishment of an electric light plant has been carried by the ratepayers of Sudbury, Ont.

Incorporation is being sought by the Mattawa Electric Light and Power Co., of Mattawa, Ont. The capital stock is $10,000.

The Royal Electric Co., have been awarded the contract for installing an electric light plant in the Seminary of Philosophy, Montreal.

A dispatch from Perth states that the council of that place has granted a bonus of $5,000 for an electric railway between Perth and Lanark.

The promoters of the electric railway for the city of Quebec have paid ten per cent. of their subscribed stock and expect to commence operations this fall.

Mr. W. R. Keating, of Kemptville, is said to have decided to establish an electric light plant at Winchester, Ont., and will commence operations at once.

A successful test was recently made of one of the three generators recently built for the Montreal electric railway. It is a duplex machine, capable of supplying a current of 1,200 h. p.

Mr. S. A. Coney, of the firm of John A. Roebling, Sons & Co., of New York, recently visited Hamilton for the purpose of tendering on the machinery required for the new East Hamilton Incline Railway.

Under the supervision of Mr. J. G. Hampton, Superintendent of the North American Telegraph and Telephone Co, a telephone cable was recently successfully laid between Gananoque, Ont., and Tremont Park.

The Hamilton and Dundas Railway has been leased by Mr. Miles, of the Hamilton, Grimsby and Beamsville Electric Railway, and will be converted into an electric road. Mr. W. T. Jennings, C. E., will have charge of the work.

The Temple Electric Co., of Montreal, are fitting up an electric light and power station on Chenneville street in that city. The new station will have double the capacity of their present one, and is to be completed about the end of September.

The new contract made between the corporation of St. Johns, Que., and the Electric Light Company provides for 30 arc lights of 2000 candle power at $60 per annum, or five incandescent lights of 25 c. p. may be substituted for one arc light. The arrangement is certainly a very favorable one for the town.

The Citizens Light and Power Co., of Montreal, are erecting a new station at St. Henri, which is to be operated by steam power. The steam plant will consist of two 320 h. p. compound, condensing Westinghouse engines and Manning vertical boilers with mechanical draft.

Last year the Western Telephone Company imported from Germany a cable half a mile long and stretched it across the Fraser River at Brownsville, B. C. The great freshet of the present summer broke one end loose, and in trying to secure it the end was lost. It is found to be imbedded in sand and clay and doubtful of recovery.

The Department of Inland Revenue at Ottawa is at present engaged in organizing the electrical inspection branch, under authority of an act passed by the Parliament last session. The result of the experiment by the Dominion Government will be closely watched, as although England and the United States have established standards of electrical units and measurements, neither of these countries has so far taken up the work of inspection.

The Niagara Falls and Port Dalhousie Electric Railway Co., with head office at Toronto, is applying for incorporation to construct an electric railway connecting Niagara Falls and Port Dalhousie, Ont., passing through the intervening municipalilics of Stamford, Thorold, Merritton and St. Catharines. The capital stock is placed at $300,000.

The promoters of the Galt and Preston Electric Railway are said to have decided on the extension of their line to Hespeler. The construction of a branch line to Berlin is also under consideration by the company. Mr. W. T. Jennings, C. E., of Toronto, recently surveyed the proposed route and reported that no engineering difficulties were anticipated.

Mr. T. Viau has been granted a franchise by the town of Hull, Que., for the construction of an electric railway and the operation of an electric light plant. Steps are being taken to organize a company, and a charter from the government is being applied for. Surveys have been made in connection with the erection of the power house, which will be commenced before the end of the year. The electric light plant will also be installed at an early date.

A company of Toronto capitalists, composed of Alexander Manning, ex-mayor, Senator Aikins, Col. C. S. Gzowski, James A. Lowell, M. P., W. M. German, M. L. A., and others, are reported to have purchased the street railway franchise of Niagara Falls, Ont., the price paid being given as $25,000. The road will be converted into an electric system. The ultimate intention is to extend the line to Chippewa, thus making a connecting link between that place and the G. T. R. station.

PERSONAL.

Mr. H. T. Smith, superintendent of the London Street Railway Company, has recently returned from a holiday trip to the Thousand Island.

Mr. J. F. H. Wyse has been appointed superintendent of the Westminster and Vancouver Tramway Co. Mr. G. Lubka, the former superintendent, is going to Germany.

WE HOPE TO SEE YOU AT THE MONTREAL CONVENTION. IT WILL DO YOU GOOD TO BRUSH UP AGAINST YOUR ELECTRICAL CONFRERES.

INCANDESCENT LAMPS: THEIR USE AND ABUSE.*

In the present state of the art of incandescent lighting, in no way can central station managers increase the efficiency of their investment more than by careful study of ways and means of operating lamps in a manner which will insure an average maximum light for a minimum expenditure.

Too large a percentage of central stations judge the quality of lamps sold them almost entirely by their life, and even that poor basis of calculation is still further distorted by keeping no ampere records nor averaging results, but judging solely by the individual records of such lamps as may fail in the first hundred hours, or of those which live hundreds of hours past the point, at which, from an economical standpoint, they should have broken. The importance to central station managers of judging lamps which are sold to them from some better basis than individual or even average life, can be better appreciated by referring to diagram No. 1, showing curves of deterioration in candle-power of lamps manufactured by different companies. (In considering deterioration in candle-power, it should be stated that it is a characteristic of every lamp which has yet been mannfactured and should be considered entirely independent of blackening or discoloration of the bulb. Lamps may deteriorate to 50 per cent. of their initial candle-power within 200 hours and still show scarcely a trace of blackening). All lamps, the curves of which are shown, were purchased within six months in the open market in lots of from 10 to 25, and the curves are the average result obtained by starting each lamp at the particular voltage which would bring the lamp to exactly three watts per candle, maintaining its voltage constant throughout its life.

Curves Nos. 3, 5 and 6, diagram No. 1, represent the best results obtained from the product of numerous foreign manufacturers. Nos. 4, 8, 9, 10, 11 and 12 each represent a different domestic manufacturer.

While there is no reason to suppose that the average life of lamps shown by Nos. 4 and 7 will be shorter than that of lamps represented by curves Nos. 10, 11 and 12, there is also no certainty that it will be longer, and if a lamp is to be branded as poor by the central station manager, because of the breakage of a small percentage of lamps in the first 100 hours, then the advantage is in favor of the lamp which reached 50 per cent of its original candle-power in the first 200 hours, thus maintaining the carbon at a high degree of incandescence with the necessarily greater strain of the filament for only a few hours.

The carbon which maintains its candle-power must continue to burn at a higher temperature, nearer the point of vaporizing, and is more likely to be destroyed by an abnormal increase in pressure than one which cools within the first few hours to a point where considerable increase in voltage is required to bring it to its initial degree of heat or incandescence.

From the standpoint of the central station, one of the worst guarantees that you could demand from the lamp manufacturer would be an individual life (for each lamp) of 100 or 200 hours. The reason for such demand, when made on your part, arises from the erroneous impression that the lamp which lives only 100 to 200 hours is necessarily defective. Nearly every lamp sold you, and particularly those which show the best results, rises in candle-power for the first few hours (this is not shown in diagram No. 1, as in only one case was the first test after the lamps were started made before the candle-power commenced to drop).

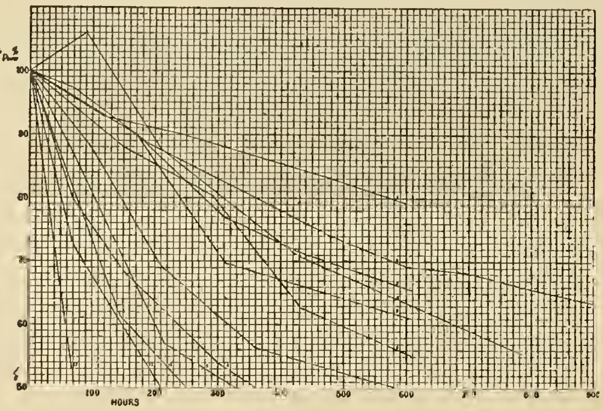


Fig 1.

On nearly every central station, particularly on alternating current stations, during light load, the pressure on the primary is abnormally high. Add to this the difference between drop in the transformers and secondary wiring, as between full and light load, and the result which a test is quite certain to show is pressure on the one or two lamps which the customer is burning during light load from 6 to 10 per cent high.

Referring to diagram No. 2, we find that burning a new 16 candle-power three and a half watt lamp seven per cent high would, for the first few hours, raise its candle-power to 25, and its efficiency to about 2.6 watts per candle. In less than 150 hours, even maintaining the high pressure mentioned, the candle power and efficiency would fall below normal; but in the meantime, the new lamps which have been burned under the above conditions have been abused to an extent which would be quite certain to make the showing of some individual lamps very poor, *through no fault of the lamps.*

After lamps have been in use about 200 hours, under average conditions, they could then be used where the pressure was high, without bringing the carbon to a dangerous degree of incandescence.

One of the best illustrations I can give of the importance of your judging lamps from some better standard than simply life, is to refer to an incident of which I had reliable information where a representative of the lamp company, who manufactured the lamps shown by curve No. 12, diagram No. 1, exhibited the valuable quality possessed by his lamp standing very high pressure. With a rheostat it was exhibited burning from normal to a very high candle-power. He represented it as the *toughest* filament ever placed in a lamp, and I have no cause to disbelieve him.

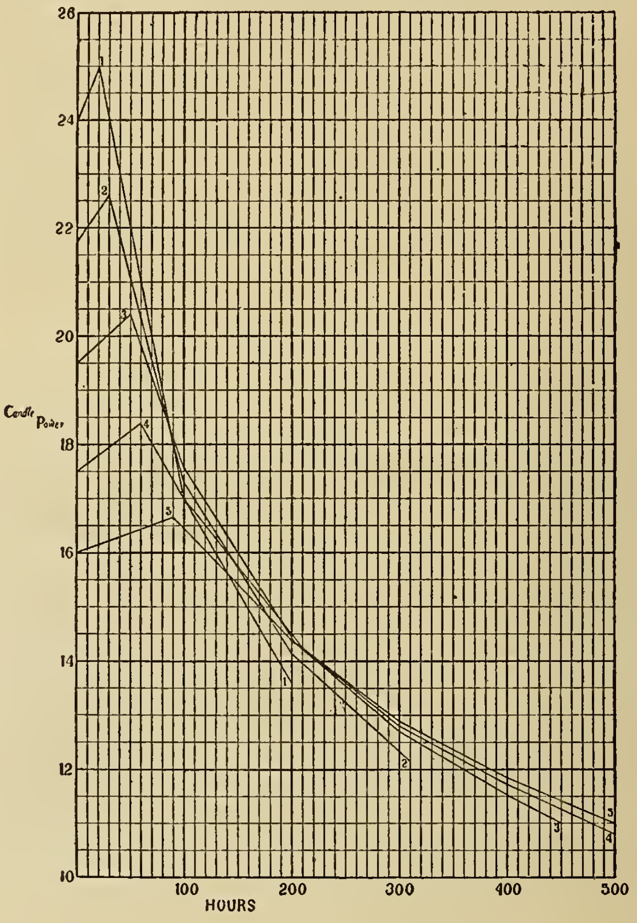


Fig. 2.

If central stations run with a variation of from 6 to 20 per cent in pressure they will find it necessary to demand *tough* lamps, the natural product of the *amateur* lamp manufacturer. To bring a product up, however, even from curves Nos. 9, 10 and 11 to No. 4, means experience and thousands of dollars spent in experiments.

It also means that each one of over 50 different operations through which the parts of a lamp pass from start to finish, should receive careful, intelligent handling or direction. Perfection in any one particular will not attain even average results.

The manufacturer of lamps shown by curve No. 4 might have furnished the same carbons to manufacturers of lamps represented by curves Nos. 10 and 11, and the result which they would obtain would not differ materially from that secured with their own make of carbons. Curve No. 4, though it represents as high an average grade of lamp of any voltage above 100 as has yet been furnished to the customers of any lamp manufacturer, does not represent the highest point which will be attained.

Curves Nos. 1 and 2 represent experimental lamps manufactured and furnished for test by the same company, whose regular product is represented by curve No. 4, and I am informed by reliable experts that within a few months the entire product of the company will be brought up to the standard represented by curve No. 1.

That the relative value of the lamps represented by these curves may be fully appreciated, let us take the average candle-power of curve No. 1, diagram No. 1, which for 600 hours is 14.19 candles, and we find, to maintain the same average candle-power, using other lamps, we should have to break lamps represented by curve No. 4 at 530 hours; No. 7 at 170 hours; No. 8 at 100 hours; No. 9 at 120 hours; No. 10 at 90 hours; No. 11 at 75 hours, and No. 12 at 35 hours.

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* Paper read before the Northwestern Electrical Association, St. Paul, July, 1894, by A. D. Page.

All of the lamps represented by diagram No. 1 are of voltages from 100 to 125 volts, and though started at a higher economy (*viz* three watts per candle) than is commonly practiced by central stations (the 3.1 standard of Edison illuminating companies being the highest of which I have personal knowledge). Testing at three watts comes nearer to results obtained by commercial practice than a lower initial economy, as the tendency of the average central station is to run high.

Diagram No, 3 represents lamps of from 50 to 60 volts, started at three watts per candle, and tested under the same conditions, as the 100 to 120 volt lamps.

No. 1 is the product of the same factory as Nos. 1, 2 and 4, diagram No. 1.

No. 2 was manufactured by the same company as No. 9.

No. 3 was manufactured by the same company as No. 11.

No. 4 was manufactured by the same company as No. 10.

As proven by these curves, and also, I believe, as generally acknowledged, it is much easier to produce a fairly good 50 volt lamp than one of a voltage above 100; but considering the progress which has been made within the past year in the high-volt lamps, I believe that in a short time a large percentage of alternating current central stations will find it to their advantage to use large transformers and secondary mains on the three wire system, covering one or more blocks from one transformer or bank of transformers and using only lamps of over 100 volts, thus greatly economizing in copper and securing much better regulation than is now secured with numerous small transformers and 50 volts on the secondary.

The importance of good regulation or a constant voltage at the lamps is too little appreciated, the general opinion of central station managers apparently being that so long as the life of the lamp is satisfactory to themselves or their customers, if they increase the voltage either temporarily or permanently, the result would be to increase the average light. The facts are that burning lamps above their normal rating decreases the entire average candle-power on the customers' circuits and, at the same time, if the station is on a meter basis, increasing the amount of the customers' bills. The above statement is particularly true of lamps only of average quality.

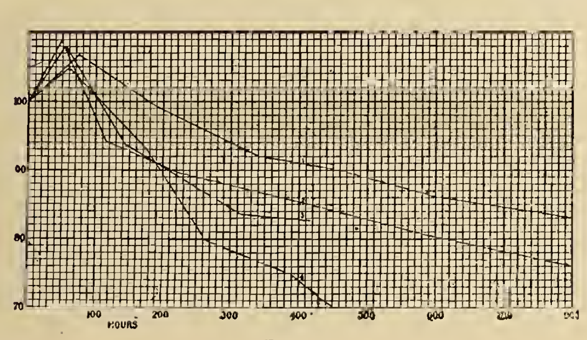

Fig. 3.

Referring to diagram No. 2, No. 5 curve represents a 108 volt, 16 candle-power, three and one-half watt lamp burned at a constant voltage and reaching 11 candles at 500 hours, starting the same lamp at 110 volts or at 17½ candles, 3.3 watts per candle and inside of 200 hours the candle-power curve crosses the one burned at normal. Starting it at 112 volts or at 19½ candles, 3.1 watts per candle, in less than 200 hours the candle-power curve crosses both the others.

Curves Nos. 1 and 2 follow the same general law. The higher we raise the voltage the more rapid the drop in candle-power, and when we consider that the lamp represented by curve No. 1 *must be kept at* 116 *volts* in order to give 14 candles of light after 200 hours, and that should the voltage be brought back to normal, or 108 volts, the candle-power would be only about nine candles, we can appreciate that on a station where the voltage varies even seven per cent, the result must be a very uneven and poor quality of light, even though the *life* of the lamp is satisfactory.

The tendency of all the central stations seems to have been to gradually raise their voltage with the intention of thus either burning out or increasing the candle-power of the old lamps on their circuits. The result is only to either burn out an abnormal number of new lamps or bring them down to the candle-power level of the old ones within 200 hours.

The only practical method of keeping the average candle-power of lamps on a station at a point which will be satisfactory to customers or on a competitive basis with other methods of of lighting, is to keep records of the average life on the entire station where free renewals are furnished, and then to take out of the sockets and break up all lamps which are dim, by this means keeping down the average life to whatever constant is decided as the best under local conditions. Where lamps are sold to the customers, to keep the candle-power of lamps in use on the circuit of a central station at a point which will ensure satisfaction or tend to keep the electric light popular, is a difficult problem. Whether the customer is on a meter or on a contract basis, it is poor economy for him to keep lamps in his sockets which are giving only 50 per cent of their initial candle-power, but for the corporation which sold him the lamps and supply him with current, to call his attention to the fact that lamps in his sockets are giving only about eight candles, and attempt to sell him lamps at 50 or 60 cents each, is not likely to bring about the desired result. To meet the above difficulties a number of central stations in different parts of the country are now selling lamps at retail to their customers at cost and a few stations even below cost, at the same time doing all in their power to prove to them that only by a liberal use of lamps can they obtain the greatest amount of light for a given expenditure of money.

As the profit on the sale of lamps is decidedly a secondary matter as compared to the sale of current and the increased quality of the light, the above plan should commend itself to all central stations not on the basis of furnishing free renewals. It is also worthy of consideration that by adopting the above plan the station controls what lamps shall be used on its circuits without dictating to its customers, an important point, while lamps show such widely different results as those shown by diagram No. 1. And while customers continue more likely to believe that the corporation is not supplying proper current, than to believe that the quality of lamps they have been purchasing is at fault.

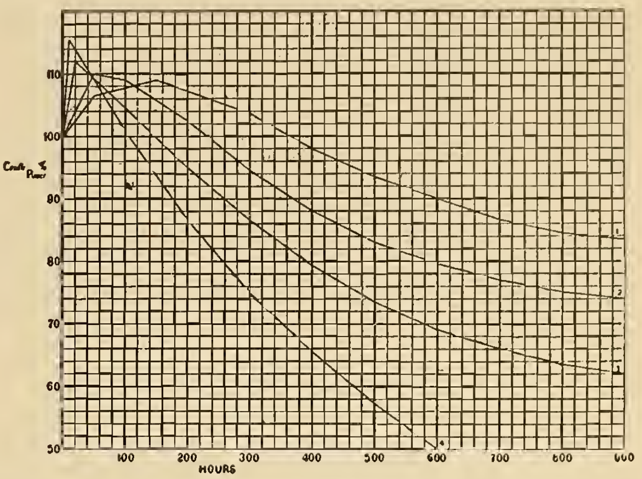

Fig. 4.

Another method of inducing customers to destroy dim lamps which has found favor with a number of stations, is to make a price for lamps of, say, 40 cents each and agreeing with their customers to exchange all dim lamps (which they have sold them) at half price, that is, for every dim lamp which the customer returns before the carbon is burned out, he receives a new lamp for 20 cents.

Within the past few months the question has often been asked me by central station managers: "What economy of lamps should we use?" This question should, I believe, be settled by central station managers themselves on presentation of facts, they having control of the regulation of their station, and knowledge of local conditions.

Diagram No. 4 shows the same quality of lamp manufacture as curve No. 2, diagram No. 1, and represents 16 candle-power lamps started at an initial economy of four, three and a half, three and two and a half watts per candle. The accompanying table shows candle-power, average candle-power, average economy and average candles per electrical horse-power at 100 hour periods in their life.

		84 Watts	58 Watts	43 Watts	40 Watts
100 Hours	C.P.	17.28	17 44	18 8	18 18
	Average C.P.	16 8	17.06	17 09	16 90
	Average Watts Per Candle	3.9	3 28	2 8	2 30
	Candles Per El.H.P.	191	227	288	318
200 Hours	C.P.	17.12	10.32	15 2	14 08
	Average C.P.	17.03	10 94	18 51	15 97
	Average Watts Per Candle	3 76	3.3	2 9	2 5
	Candles Per El H P.	198	220	257	298
300 Hours	C.P.	18 64	15.04	13 92	12
	Average C P	16.98	10 53	15 86	14 98
	Average Watts Per Candle	3.77	3 39	3 03	2 07
	Candles Per El H.P	198	220	246	279
400 Hours	C.P	15.68	14.08	12 8	10 56
	Average C P	10 74	16.	15 2	14 03
	Average Watts Per Candle	3.82	3 5	3 18	2 85
	Candles Per El.H P.	105	213	238	262
500 Hours		15	13.28	11.08	9.12
		10 45	15.57	14 62	13.2
		3 89	3.59	3 28	3 03
		192	208	227	246
600 Hours		14.40	12.8	11 04	8.
		16.	15.15	14 08	12 43
		4.	3 7	3 11	3.22
		187	202	219	232
700 Hours		13 92	12 32	10 58	
		15.84	14.78	13.63	
		4.04	3.70	3 52	
		185	107	212	
000 Hours		13.6	12.	10 24	
		15 8	14.45	13 23	
		4.1	3.88	3 82	
		182	102	208	
000 Hours		13.28	11.84	9.92	
		15 36	14 10	12 88	
		4.17	404	3 73	
		179	180	200	

Table

In considering these curves and table it should be remembered that the result would have been much less favorable to the higher economy lamps had the test been made and the curves plotted with a poorer quality of lamp, and also that satisfactory results with lamps of higher economy than three and one-half watts per candle can only be obtained by exercising the greatest care in maintaining a constant voltage at the lamps. Referring to the table briefly, it will be found that even at 600 hours, lamps of the highest initial economy show the best average results as to average watts per candle and average candles per horse-power. And that at 900 hours three watt lamps show better average results than lamps of 3.6 or four watts. The greatest objection which can be urged against the high economy lamp is that while at 900 hours the four watt lamp reaches a minimum candle power of 13¼ candles and the three and one-half watt lamp about 12 candles, the three watt lamp reaches 10 candles and the two one-half watt lamp at 600 hours reaches eight candles. At the present price of lamps, where fuel is high and the customers' bills are made up on the basis of lamp hours, it would, without question, pay the station to use high economy lamps, breaking them at a point which would insure satisfaction as to average light and keeping the average light comparatively short.

Whatever economy or make of lamp you decide to use, by no means can you so greatly increase the efficiency of your station as by making every possible effort in the direction of maintaining a constant voltage at the lamps. This can only be accomplished and maintained by constant use of reliable, portable instruments. No switchboard instrument should be relied on without often checking it by some reliable standard, and it should also be borne in mind that, owing to the varying drop at various loads, constant voltage *at the station* is just what is not wanted. If you do not possess a reliable, portable voltmeter, such an instrument should be your next purchase; then by constant use on your circuits at different loads and *profiting by the knowledge thus obtained*, you would soon find a marked improvement in your lighting, and would be in a position to judge which make and what economy of lamp is the best for you to purchase.

ELECTRICAL METERS.*

By Cecil Doutre.

An indispensable adjunct to the installation of the electric light supplied with current from the mains is the electric meter to measure the amount of current consumed. Up to the year 1887 there were few, if any, practical meters on the market, with the exception of a few continuous current ones which were for the most part of the Edison chemical type. In the year 1887 Prof. Forbes exhibited his heat meter before the American Institute of Electrical Engineers; where it caused considerable comment and received a great deal of well deserved admiration. Although this meter was not all that could be desired (for reasons which we will consider later on), it marked an important era in the history of recording meters, and stimulated those who had been working in this field to such an extent that in an exceedingly short time a great many meters made their appearance, the majority of which were condemned, and to-day there are not more than six or seven meters which are used to any extent in this country or abroad. Nevertheless, there are a great variety of meters which, although they may not be thoroughly practical, are very interesting indeed, as they show how the various properties of the electric current are made use of. Of these there are the following:—the motor, chemical, thermo, clock, and several others. Before discussing their good and bad features, we will consider what points a good practical meter should possess.

An electrical meter, to be practical and to achieve any commercial success, should have a direct-reading dial, should be extremely sensitive, so as to register accurately on a light as well as a heavy load, should be free from all complicated mechanism, and where the element of friction is introduced, it should be reduced to a minimum, so as not to destroy its accuracy. A practical meter should not be affected by atmospheric changes.

We will now discuss some of the meters which are in use to-day and see how many possess the foregoing points. We will first take those which come under the head of motor meters. There are only three of these meters used to any extent in this country, viz:—the Shallenberger. Slattery and Thomson meters. They are divided into two classes: those actuated by inductive principles and those whose motive powers act direct, and which are similar in character to the electric motor. The Shallenberger belongs to the former class, and is a recording ammeter, and while highly practical, is scarcely all that could be desired for several reasons, all of which tend to introduce errors, as we shall see. The principle upon which this meter operates is as follows: The small armature, composed of a soft iron ring, is mounted by means of an aluminum disc, on a shaft, which actuates a recording dial; the armature is surrounded by a number of flat copper stampings riveted together, which form a short circuited secondary coil of low resistance, and this in turn is surrounded by two coils of wire carrying the current to be measured. The last named coils are in series with the lamp circuit, and which we shall call the primary. When an alternating current passes through the primary coil, alternating currents are induced in the secondary. These two fields of force produce a revolving field resulting from the lag of phase of the current between the two coils, and the armature tends to revolve in unison with this revolving field. Meters, as a class, revolve far more rapidly than is allowable in practice, and a resistance, or drag, is introduced to reduce the speed. In this meter four air fans are attached to the lower end of the spindle, and have the desired effect. This, as I said before, is a highly practical meter, for atmospheric changes have very little effect upon it, and it will stand considerable knocking around. However, the meter has its weak points, viz:—that there is no means introduced to balance friction such as are found in the Slattery or Thomson meters, and the principle involved to produce the necessary "drag," or retardation, tends to introduce errors, and the result is that the speed of rotation is not in exact proportion to the volume of current passing through the meter. The resistance of the air fans to rotation is approximately proportional to the square of the speed, but since the torque of this meter does not quite reach the square (this would indicate that the iron was approaching saturation), the retarding effect of the fans increases rather too rapidly, which naturally has a tendency to cause the speed of the meter to fall off proportionately on high loads. This meter is also affected somewhat by variation of frequency. The speed of rotation is governed by the angle between the planes of the primary and secondary coils, and attains its maximum speed when the angle is 45 degrees, and will not run at all if the two planes are either parallel or perpendicular. Summing this meter up we find that on a light load it will measure the hours, but will not correct for the angle of lag, and again on a heavy load the speed of the meter has a tendency to be reduced on account of the retarding effect increasing too rapidly, as the torque of the meter does not quite reach the square. Nevertheless, this meter has been favorably received by station managers generally, as a thoroughly practical instrument, and has been found to measure accurately enough for all commercial purposes.

The Slattery meter is somewhat similar to the Shallenberger, both in construction and in principle of operation. Two soft sheet iron rings are mounted upon a copper drum on a perpendicular shaft, or spindle, which is surrounded by a series of copper castings, and surrounding this are two coils of heavy wire which carry the current to be measured. An accessory coil of fine wire is wound upon the main coils, or primaries, and is so proportioned that the torque resulting from it is just sufficient to balance the drag due to friction and, therefore, greater accuracy is attained on light loads. The means introduced in this meter to cause the necessary drag is certainly by far the best. A small inefficient dynamo, in form of a copper tube, is attached to the lower end of the shaft and is rotated in a magnetic field. The resistance, of course, is directly proportionate to the speed, and therefore to the torque, being in fact the machine reversed. By applying this drag the only difficulty to contend with is the friction, which is fully compensated for by the accessory coil of fine wire. This meter, if properly proportioned, will give a highly accurate result both on a light and heavy load. The old style of Slattery meter was almost the same as the present one, except that instead of only having two iron rings on the drum there were five, and the mode of causing the necessary drag is somewhat similar to that introduced in the Shallenberger, only the fans were so constructed that as the speed increased they would close up, thus reducing the exposed surface.

The Thomson meter is simply a motor without iron, and is somewhat of a departure from the rest of alternating current meters, as it is not a current meter, but a power or watt meter, and will record equally as well on both alternating and continuous currents. Its construction is quite similar to the ordinary shunt motor, the conditions of field and armature being reversed. The main current flows through the field and the armature is in series with a high non-inductive resistance, and is connected across the mains. Therefore the meter is not affected by variation of frequency. An accessory coil of fine wire is introduced in this meter, as in the Slattery, which is so adjusted that its torque is just sufficient to balance friction, and as the armature is nicely poised the meter will register an exceedingly small current. Therefore, in considering the principles of this meter both friction and the accessory coil may be neglected. Rotation is retarded by a copper disc rotating between the poles of permanent magnets. The resistance is directly proportioned to the speed, and therefore to the torque. This meter proved itself so accurate at the recent meter competition in Paris, some two or three years ago, that it succeeded in dividing the first prize of 10,000 francs and a gold medal with the Aron clock meter, which we shall consider later on.

The Edison chemical meter:—The principle upon which this meter operates is electrolysis, and in its original form consisted of two copper plates suspended at the end of a balance and dipping into a solution of sulphate of copper; a current continually traversing the liquid in the same direction caused one plate to gain and the other to lose in weight, the result being that after a certain quantity has been deposited on one plate the balance swings over; in doing so it reverses the current and registers a unit on the counting mechanism; as the current now flows in the opposite direction the lighter plate gradually gains in weight, so the balance swings over again, and so the action goes on. This method of making the chemical meter register the quantity of current consumed automatically, although highly ingenious, was abandoned, as the element of friction was introduced to such an extent as to make the meter unreliable. The present form of the Edison chemical meter bears little or no resemblance to the former one, except that it depends upon the same principle for its operation. Zinc plates and a solution of zinc sulphate are used in this meter. A resistance of German silver is interposed in the lamp circuit, which shunts only a small proportion of the current through the meter. In the old style of this type the exact amount is 1-975th part of the total current, or practically speaking the 1-1000th part is shunted through the cell, which is placed in this shunt circuit, and the rate at which the zinc is deposited on the negative from the positive, is in direct proportion to the current consumed. The positive plate is weighed before being placed in the cell with the negative plate, and after the cell has been in service for a stated time it is replaced by a new one and the old one returned to the station to be weighed over again to find out how much the positive plate has lost. The French metric system is used in weighing these plates. One amp. of current will deposit 1224 milli-grammes of zinc in one hour, therefore it is only necessary to multiply the amount the positive has lost by 975, and divide by 1224, which will give the number of amperes; but a shorter way of doing this is to multiply the loss by a convenient constant, which will give you the amount in dollars and cents. This meter is affected by changes of temperature, and to compensate for this a coil of very fine wire is inserted in the shunt circuit (which is called the compensating coil). As the resistance of all metal solutions increases as the temperature falls, and decreases as the temperature rises, and as the effect of the temperature on a coil of fine wire is exactly the reverse, the compensating coil is so proportioned that as soon as the resistance of the cell increases from a fall in temperature, the resistance of the fine coil of wire decreases in the same proportion, so that no matter what the state of the temperature is, the resistance of the shunt circuit is always the same. Another drawback of this meter is, that the cells are liable to freeze in cold weather, and to overcome the above defect a very ingenious device has been introduced called a "thermostat," which automatically lights a lamp if the temperature falls below 27°, and which consists of two thin strips of metal—one of brass and the other of iron—riveted together. The coefficient of expansion of these two metals is not the same; as brass contracts quicker than iron it has a tendency to curve or bend the strip, and in doing so makes contact and lights the lamp, immediately upon which the surrounding air is heated, and the strip expands, breaking the circuit. This action goes on as long as the temperature is below 32°, as the solution freezes at 27°, and it is always good practice to allow 4 or 5° for the safe working of the thermostat. The zinc plates go through a regular process before they can be used again. After being returned to the station and reweighed, they are ground to a clean surface, amalgamated, dried, scraped with an engraver's scraper, and about one inch of the copper rod and the top of the plate is painted with asphalt varnish; it takes a plate from 36 to 48 hours to go through the above process. The size of the plates in this meter increase in proportion to the capacity, so that in a 200 lt. meter the plates reach a size which is very awkward to handle; it is somewhere in the neighborhood of 6½in. long, 3in. wide, and 5-16in. in thickness. Take eight such plates, four glass cells which are capable of holding 1½ quarts each of solution, and one gains an idea of what it means to change a number of these meters, especially if they are any distance from the station. In view of the above facts one wonders how the Edison meter ever came to be used to the extent it was. The reason is however not far to seek, for at the time they were placed on the market there was practically no reliable meter to compete with it for straight currents, and station managers were only too glad to accept anything in the metering line, as the flat rate or contract policy which was in vogue was the ruination of a good many companies. The only point in favor of the Edison chemical meter is, that if properly operated it will return exceedingly accurate results. For laboratory work they are splendid, but if used to any extent they are extremely expensive to operate and very cumbersome. The latest style of Edison chemical meter is a decided improvement on the old style, but even now they leave a great deal to be desired. The plates for all size meters are of uniform size—about 1+2×5-16. The German silver shunt, instead of being so proportioned as to shunt the 1-975 of the total amount consumed through each size of meter (or having the same ratio), has a different ratio for each size—that is to say, if in a 6ft. meter the shunt shunts the 1-975 part of the current consumed through the cell, in a 12ft. meter the shunt will only shunt the 1-1950 part through the cell; by making this important change the plates and cells are all of one size. The result is reached by multiplying the loss by a different constant for each size. The successful operation of this meter depends upon a good many conditions. The water for the solution must be the purest water obtainable; it should be distilled, and the next best thing is melted ice. The salts must be chemically pure. Great care must be taken to get the positive plate in the positive clip. This is found out by using a piece of paper soaked in potassium iodide and in passing a current through it. If a brown mark is left it is the positive, if no mark is left on the paper it is the negative. Allowance must be made for oxidation also.

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*Paper read before the Montreal Electric Club.

The Aron clock meter, although little known in this country, is used quite extensively on the other side, and consists of two distinct clocks—one is of the ordinary kind of every day clock which oscillates regularly, and the other has a permanent magnet at the extremity of its pendulum, a coil of wire in series with the working circuit surrounding it, which carries the circuit to be measured. The effect of this coil either retards or accelerates the movement of the pendulum according to the direction of the current. If there is no current passing through the coil the two clocks run in unison, but immediately one is retarded or accelerated the difference in speed is registered in electrical units by a differential speed, counting mechanism. This meter may be used for registering alternating currents by substituting a coil of fine wire in place of the magnet. These clocks have to be wound up every two weeks, and are found to give very good results.

The Oulton and Edmonston meter is upon the same principle as the Aron, and consists of two tortion pendulums instead of two gravity pendulums, which are actuated by the twisting of a fine wire; one pendulum carries permanent magnets, and underneath are two copper rods carrying the current to be measured; the effect of the current is the same as in the Aron meter. The superiority of this meter over the Aron is, that having tortion pendulums, it will run much slower and therefore does not need to be wound up so often.

The very latest syle of alternating current meter is due to the ingenuity of Messrs. Wright and S. Z. Ferranti, and consists of two vertical electro magnets, the pole pieces of which are drawn out into peculiar curved horns, so to speak. Around the horns are wrapped at intervals thin copper bands. Between the horns or pole pieces is placed a light copper wheel attached to a spindle, to which are attached light mica vanes to cause the necessary drag. The current passes through the electro magnets and causes lines of force to traverse from one horn to another. The passage of these magnetic lines of force, however, through the copper bands, tends to induce momentary currents in them, and these momentary currents tend to obstruct the passage of the magnetic lines of force which do not all traverse the pole-pieces at its tip by puff out, so to speak, at every band of copper, and induce currents in the copper wheel which causes it to be repelled and continuously rotated. The wheel actuates the usual counting gear. Of course this meter will only register alternating currents.

The Forbes meter is based upon the heating effect of the current; therefore the meter can be made without any appreciable self-induction, and can be used for both straight and alternating currents. It consists of two concentrix copper rings bridged across by a number of fine wires. The current enters one ring and leaves by the other, passing through all of the wires in parallel, the resistance offered by the wire being about 1-100 of an ohm. A number of air fans are placed over the fine wires inclined at an angle of 45° to the horizontal. As soon as the wires become heated by the passing current the surrounding air is heated, so that a continual upward current of air is maintained during the whole time that the current is flowing—the strength of the air current varying of course with the extent to which the wires are heated. The steel pinion supporting the fans is geared into a train of wheels which records the number of revolutions in the usual manner. It will be readily apparent that since the force which causes the rotation is so feeble, the slightest friction would be inadmissable, and the whole of the moving parts must be extremely light and delicate. Beautiful as the principle is, it is feared that it would be difficult to develop it into a practical meter. Like a great many other meters which have appeared from time to time, in theory they work like a charm, but in practice they fail to come up to expectations.

ELECTRIC MOTORS.

AN ELEMENTARY EXPLANATION AT THE REQUEST OF SEVERAL OF OUR READERS.

It will probably be more easily understood if we assume to have a permanent magnet for the fields of our motor, which has the horseshoe form, and the armature for the present will be a straight-bar magnet whose polarity we can reverse at will. These are shown in Fig. 1. We know from experiments with a horseshoe magnet and a compass that the north pole of the needle will follow the south pole of the magnet, while the south pole of the needle will be repelled by the south pole of the magnet, and this is our starting point. Starting with our pivoted-bar magnet (which we will call the armature) in the position shown we can readily see that the north pole of the armature will be attracted by the south pole of the magnet, while the other poles are similarly attracted, and as the similar poles repel, all the forces act to turn the armature as shown by the arrow.

When the armature has turned so as to lie at right angles to this position, as shown by the dotted lines, we see that it will move no further with its polarity as it is in the position to be attracted most strongly, and there are no repelling forces at work. This gives the shortest path to the lines of magnetic force which are supposed to flow from the north pole of the magnets back to south pole and so continue, and as the shortest magnetic path is always the earliest travelled, this is in its strongest position, as fewer of the lines are scattered in the air. If, now, our armature is a permanent magnet, it will remain here and refuse to turn except with outside force, and for that reason we must have it so that we can make it changeable, and in practice electro-magnets are used in places where this is necessary.

Considering that we can change the polarity of the armature at will, we will now reverse it, and as the momentum has carried it slightly past the center, we find that the poles are now repellant and tend to make a half revolution until they have their poles arranged as before, north to south and south to north. From this we can readily see that if we reverse the polarity of the armature twice every revolution, just as it passes the center of the pole piece, we can get a continuous rotary motion, although it will be readily seen in this case the power will be far from uniform, as there are two points of maximum strength and two of minimum, the former when the armature is just midway between the poles as in the first position and the latter when as shown by dotted lines. By making an armature with numerous poles, as in a coarse-toothed gear, and having each tooth wound with wire from a battery to form poles, we might get a uniform pull as there would be part of them at maximum and part at minimum strength all the time. But we will now abandon this idea, and go into the electric motor as it really is. We have used the magnets as their action is familiar to all, but in every-day practice we employ a different theory and process.

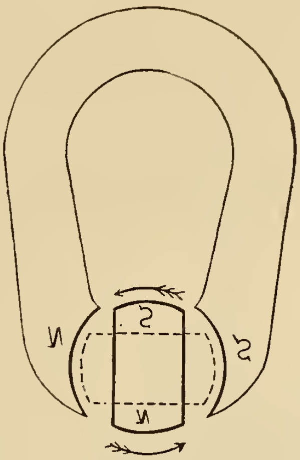


Fig. 1.

It is well known that by winding a soft iron bar with insulated wire and passing current through it we make a magnet much stronger than any steel or permanent magnet. This we call an electro-magnet, and by simply reversing the direction of the current passing through it we reverse its polarity, so we have it under entire control.

We make our field magnets of soft iron or soft steel, and wind them as before stated in order to get a very strong magnet, and for the armature we use soft iron (formed of thin sheets or disks of iron separated by paper, called laminations), and have our winding outside of this. But instead of relying upon the magnetism of the core and the attractions of the field as generally supposed and as our first illustration would show, we merely use the iron core to help the lines of force across the space between the pole spaces and to concentrate them instead of having them scattered in space. It is found that a loop of wire having a current passing through it will tend to set itself at right angles to the lines of magnetic force when placed in their path as it is in the case of the armature between the pole pieces. It is upon this law, that the action of motors is based, as the polar armature is not nearly as efficient in action as the other.

The law is, that any loop of wire carrying a current will set itself so as to enclose the greatest number of magnetic lines, and this is at right angles to the lines of force. The direction which the loop will take in moving to enclose the greatest number of lines depends upon the direction of the current through it, and this gives us control of the motor by making it revolve in the direction we wish, according to the direction we send current through it.

The different loops on the armature are brought out to separate copper bars, insulated from each other, and altogether forming a cylinder or commutator, as it is called, on which the brushes conveying the current rest. As the segments pass under the brushes the coils connected with them receive current and tend to set themselves at right angles as before stated, and when they have reached this they pass from under the brushes and the next coil receives the current and proceeds in the same manner.

This, in simple language, is the operation of the electric motor of to-day, and it was deemed best to use the magnetic illustration at first as most people are familiar with that, but the other is not so far different from it except in making a more powerful motor than is possible by depending solely upon the magnetic attraction of metals.

In another paper we may go into more detail in this matter, and give more attention to the regulation of motors and to that bugbear of the student—counter-electro-motive force.—American Mechanic.

MONTREAL JUNIOR ELECTRIC CLUB.

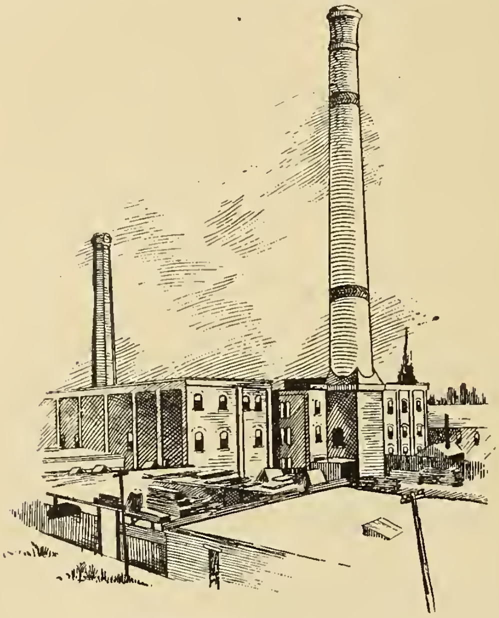
The Montreal Junior Electric Club, whose meetings have been discontinued during the summer months, will hold their first meeting on Sept. 3rd inst., at No. 6 Richmond Avenue, when arrangements are to be made for their work during the coming winter. The Club will hold a regular meeting every Monday evening at 8 p. m., until further notice. Any person wishing to become a member of this club may do so by sending in their application to Mr. E. W. Sayer, No. 6 Richmond Ave., Montreal.

EVERY PAST CONVENTION OF THE CANADIAN ELECTRICAL ASSOCIATION HAS BEEN A SUCCESS. THE COMING ONE IN MONTREAL PROMISES TO BE NO EXCEPTION TO THE RULE.

ELECTRIC RAILWAY DEPARTMENT.

NEW CHIMNEY AT TORONTO RAILWAY COMPANY'S POWER HOUSE.

We present to our readers herewith an illustration of what is claimed to be the tallest chimney in Canada, its height being 250 feet. It has recently been completed at the power house of the Toronto Railway Company, under superintendence of Mr. James Hill, and was commenced during the early part of last March. Excavations were made to a depth of 18 feet, at which point solid rock was struck. The concrete foundation, 40 feet square, is built on the rock, and was tapered up until it stood 24 feet square at the surface of the ground, where the chimney proper was begun. For the first 50 feet the chimney is square, the top which is 18 feet 3 inches in diameter, being capped with cast iron. The inside diameter is 12 feet. A ladder made of U-shaped irons is provided as a means of ascending, the ends of the irons being anchored in brick. The smoke from 10,000 horse-power of boilers can easily be carried by this chimney. An excellent view of the City of Toronto is afforded from its pinnacle.


CHIMNEY AT TORONTO RAILWAY COMPANY'S POWER HOUSE.

THE ALDERMAN'S DREAM.

THE alderman dreamed that he was dead and with great fear and trembling he stood before the pearly gates, and knocked ever so timidly.

"Come into the ante-room," said a voice.

The alderman obeyed with the same alacrity he had always shown when on earth he was called into the ante-room to participate in a star chamber session. Then he saw an immense pair of scales and the clerk of the court dressed in white, with a pen interrogation pointed behind his ear. He trembled, for he realized that his time had come for weighing in, and, as he carried no weights in his pockets, he might be found wanting.

"Where do you come from?" thundered a voice, now no longer mild.

"From London, Ontario," replied the quaking alderman, as he thanked his lucky star that it was not Hamilton, for in that case he would not have stood any show at all.

"What was your course on the electric railway question?"

The alderman's conscience smote him, yet he managed to reply, "I wanted cheap fares."

"Is that all?"

Was that all! The alderman was going to laugh outright, but he remembered where he was. "No," he replied. "I wanted a percentage."

The clerk's pen was working like lightning. "What else?"

"Mileage," answered the alderman, unabashed and beginning to feel at home.

The man with the pen was looking black and putting down marks equally sombre. "What else do you want, pray?" He was sarcastic now.

"The company to supply the paving material."

"Go on."

"And to supply all labor."

"Yes."

"And pave or repave whenever the city said so."

"Anything else."

"Well yes. I wanted the line to run past some promising real estate that I owned. Of course it meant crossing several railroad tracks, but then you know it would have increased the value of my property."

"Nothing else, I suppose!" asked the white-robed scribe as he prepared to cast up accounts.

"Hold on," cried the alderman, as his bosom swelled with conscious pride, "we wanted the company to employ only home labor, and work their men only ten hours a day."

"Did you do that because of your love for the working men, or for votes?"

The alderman was candid. He knew it was a not time for levity. "Votes," he replied as he hung his head.

"Look here, alderman," spoke up the book-keeper, "you want neither heaven nor earth. First elevator to the left going down. Next!"

And the alderman woke to find the council in full session.—London, Ont., Advertiser.

RAIL WELDING.

EVERY street railway man, says the Street Railway Gazette, will feel an interest in the experiments now being tried in electrical rail welding. Aside from the supposed advantages which it will give as against electrolysis, it will have inherent advantages of no mean import. Could we have a continuous rail the item charged to depreciation on the books of the company would certainly be divided by half. The comfort of the passengers would be increased twofold, and the traffic would on this account be largely increased. Greater speeds would be possible with the same factor of safety and a lower factor of expense. The first company to realize all these benefits to their fullest extent will undoubtedly be the Nassau Street Railway Company of South Brooklyn, whose operations in the rail welding line were illustrated and described in a recent issue of the Gazette. It is contemplated to weld something over 30 miles of track—all in Kings County, and over the whole of which one may ride for a single fare. The Nassau Company evidently means business, as it is sparing no expense to make their roadbed the best that can be made. Among other extraordinary expenses that they are putting themselves to is the rail welding, which we understand costs them $3 per weld for the welding alone. Now, at $3 per weld the extra expense for this alone will amount to over $10,000 per mile. However, if the welded rail proves a success this will be money well invested, and will pay for itself over and over again in a few years in the lessened wear and tear of rolling stock and track.

SPARKS.

It is estimated that the Winnipeg Electric Street Railway carried 393,000 passengers during Exhibition week.

The employees of the Montreal Street Railway Company held their annual picnic at Sohmer Park on Thursday and Friday, the 29th and 30th of last month.

Mr. Wm. Hossack has been elected president of the Quebec Street Railway in place of the late Mr. St. Michel, and Mr. Gaspard Lemoine succeeds Mr. Hossack as vice-president.

The Montreal Street Railway Company have recently placed on their lines special smoking cars for the accommodation of smokers. They are said to be well patronized and appreciated.

It is reported that the Canadian Pacific Railway proposes to use electricity for moving its trains over the Rocky Mountain division of the line. The method is to be tried first at Kicking Horse Pass.

The City and Suburban Street Railway Co. has agreed to accept a bonus of $5,000 from the Town Council of Weston, Ont., for the extension of their line from Toronto Junction to that town. A by-law will be submitted to the ratepayers at an early date authorizing the Council to grant the bonus.

The City Council of Guelph, Ont., has granted a 30 years' franchise to Mr. George Sleeman for the construction of an electric railway along the streets of that city. The necessary legislation will be obtained as soon as possible, and work will be commenced early next spring. It is probable that the line may be extended to connect with the Galt and Preston electric railway.

The Belt Line Railway Company, of Montreal, are making preparations to proceed with their projected line. The route for the eastern section of the island is already surveyed, which will be the first to be constructed. The line will start at Hochelaga, follow the shores of the island to Sault au Recollet, and then make a cut across the island to the C. P. R. tracks at Hochelaga. The elevated railway through the city will be built the last of all.

It has been reported during the past month that the Grand Trunk belt line around the city of Toronto would shortly be converted into an electric road, and that arrangements were being made for the change. It is learned from Mr. Edmund Wragge, the local manager, that the company has been considering the question but no decision has as yet been arrived at, owing to the great difficulty in adopting the electric system on account of the numerous trains between the Union Station and the Don.

The Toronto Railway Company have lately put in operation three electric street sprinklers, consisting of tanks holding from 2,800 to 3,000 gallons of water, and which will sprinkle without refilling, about ten miles of track. Only one track is sprinkled at a time; thus the sprinkler does not require to be shut off when passing a car on the opposite track. The city supplies water to the sprinklers free of charge. The tanks are filled in about five minutes time, from large hydrants specially placed for the purpose at the ends of the street railway lines. The width of roadway sprinkled is about 16 and one half feet. Eighty miles of track per day are sprinkled; each route being sprinkled four times per day.

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TRADE NOTES.

The London Machine Tool Company recently made a ten-ton fly-wheel for the new water works pumps at Springbank.

Messrs. Wm. Kennedy & Sons, of Owen Sound, have shipped $10,000 worth of machinery and castings for the lock-gates at Sault Ste. Marie.

We learn that it is the intention of a well-known American company to establish in Canada, shortly, a factory for the manufacture of accumulators.

The Canadian General Electric Co. have recently received from the Toronto Railway Co. a contract for 1,200 h. p. generator. The machine will weigh about 50 tons.

The Bertram Engine Works Company have recently erected in the power house of the Toronto Railway Company a large engine of 1,000 horse power, valued at $25,000.

The extensive manufactory of the Siemens-Halske Co., at Chicago, was burned during the past month. The company have secured other premises and will as soon as possible resume business on a larger scale than before.

Messrs. John Starr, Son & Co., of Halifax, Nova Scotia, have issued a new catalogue of convenient size giving illustrations and full particulars of their "Unique" telephones, accompanied by a number of testimonial letters from users of these instruments.

In the last number of the ELECTRICAL NEWS the statement was made that the town of Carleton Place had withdrawn its offer of a bonus of $20,000 to Messrs. T. W. Ness & Co., of Montreal. It has since been learned that Messrs. Ness & Co., in view of the financial difficulties which they have recently encountered, requested the town authorities not to submit the bonus by-law to a vote of the ratepayers at present.

An Ottawa paper describes as a "poem in car architecture" a new car just completed by the Ottawa Car Co. for the Toronto and Scarboro Electric Railway. It is of novel design, painted in enamel white with peacock feathers at the corners and gold stars for a border line on the panels. The monogram T. & S. R. is worked upon each vestibule. The interior is of elegant finish and the name of the car "Lalla Rookh" is significant of its beauty as a whole.

As will be seen by reference to our advertising columns, a new electric concern has been started at 146 York Street, Toronto, trading under the name of The Jones & Moore Electric Co. They purpose carrying a complete line of electric supplies and machinery, including dynamos, motors, transformers, etc. Particular attention will be paid to the repairing of all kinds of electric apparatus, and all work will be in charge of competent and experienced men. The company have secured the agency for McDonough's electric damper and pressure regulator for steam boilers, something entirely new in this line, and they have letters from recent purchasers stating that a saving of from 9 to 14 per cent. has been effected in their fuel bill, in addition to maintaining a steady and uniform pressure, so desirable to all steam users and especially electric plants. The members of this firm have had several years experience in the electric business, and we anticipate a prosperous future for the company under their management.

It is currently reported that Mr. Thomas S. Bell, civil and hydraulic engineer, has been engaged by local capitalists of Hamilton, Ont., to report on the possibility of utilizing the water power at Chedoke Falls for electric lighting purposes.

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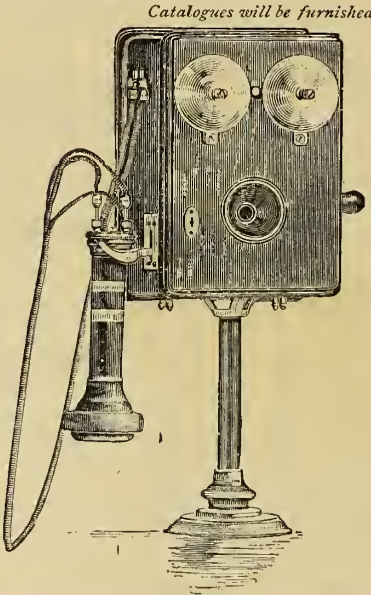

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SPARKS.

The Valley Telephone Co. have decided to extend their line to Digby, N. S.

A new telephone line has been put in operation between Brockville and Athens, Ont.

The Crossen Car Mfg. Co., of Cobourg, Ont., are building new work shops, at a cost of about $20,000.

The ratepayers of Bracebridge, Ont., have carried a by-law authorizing the Council to purchase an electric light plant.

The Light Heat and Power Co., of Newmarket, Ont., are said to contemplate the purchase of an incandescent lighting plant.

The contract with the Hamilton Light and Power Company for lighting the streets by electricity has been renewed for another year.

The town council of Newmarket, Ont., is asking for tenders for electric street lighting for a term of five years. 21 arc or 100 incandescent lights are required.

The annual general meeting of shareholders of the Great North Western Telegraph Company will be held at the company's offices in Toronto on Wednesday, the 26th inst.

The Buckingham, Que., council, with one dissenting member, has decided to submit a by-law to the ratepayers to raise the necessary money to purchase an electric light plant.

The electric light plant at Port Arthur, Ont., owned by the Port Arthur, Water, Light and Power Co. was destroyed by fire a fortnight ago. Steps have been taken to install a new plant.

The Canadian General Electric Company have secured a contract to furnish the Toronto Railway Company with a 1,400 h. p. electric power generator. This will be a mammoth machine, and will weigh not less than 50 tons.

The electric railway between St. Stephen, N. B., and Calais, Me., is nearing completion. The wires have been strung and the greater part of the track is laid. When completed the promoters claim it will be one of the best equipped roads in Canada.

At Haute Rieve, on Saturday, August 25th, was held the 16th annual Rhode Island clam dinner tendered to the electrical fraternity by the American Electrical Works. As on former occasions there was a large attendance and much enjoyment.

At the annual meeting of the New Brunswick Electric Telegraph Company held at Rothesay, N. B., recently, the following directors were elected: C. W. Weldon, president; D. C. Dawson, secretary; T. J. Almon, J. J. Tucker and D. M. Sutherland.

The Vancouver and Westminster Tramway Company is being offered for sale by tender by the Montreal Safe Deposit Company. Their lines extend throughout the City of New Westminster, B. C., and between that city and the city of Vancouver. The date limit is the 24th of November.

The council of the village of Hintonburg, Ont., will shortly submit a proposition to the Ottawa Railway Company for the extension of their line to the village. As the right of way is yet to be secured and the question must also be voted on by the ratepayers, it is not probable, should an agreement be reached, that the work of construction will be commenced this year.

A company has been formed at Rat Portage, Ont., to develop the Assiniboine water power at that place for manufacturing and electrical purposes. The scheme is well advanced, and an offer to furnish the city of Winnipeg with 5,000 horse-power will be submitted to the council at an early meeting. The electric power will be transmitted to the city by a heavily insulated wire. The distance is about 150 miles.

Messrs. W. R. Brock, president; F. A. Nicholls, general manager; George A. Cox, R. Jaffray, H. P. Dwight and Hugh Ryan, of Toronto, composing the Board of Directors of the Canadian General Electric Company recently made a visit of inspection to the company's works at London. They were shown over the premises by the local manager, Mr. C. B. Hunt, and expressed themselves as well pleased with the appearance of the works.

The Canadian General Electric Company are reported to have issued a writ to recover payment for an arc and incandescent lighting plant sold a year or two ago to a syndicate of citizens of Port Dover. It is said to be the intention of the owners of the plant when the case reaches the courts, to set up as their defence that they were induced to purchase the plant on representations made to them by the sales agent that a certain water power situated about two miles from the village could be utilized to operate the plant at a trifling expense for power. Subsequently the purchasers employed experts to examine the water power and they have reported that it is insufficient for the purpose. The case will probably turn upon whether any guarantee was given in writing to the purchasers that the water power in question was available and adequate to operate the plant. In the absence of such a guarantee the objection to making payment is likely to be set aside.

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Notice is hereby given that the time for receiving tenders for electric and gas lighting and electric light plant for the City of Toronto has been extended from the 1st of September to the 15th of September next, of which all persons interested are requested to take notice.

W. T. STEWART,
Chairman Committee on Fire and Light.
Toronto, August 25th, 1894.

TENDERS WANTED

Tenders will be received by the undersigned until SATURDAY THE 15TH OF SEPTEMBER, 1894, for furnishing

ELECTRIC LIGHT

for the Town of Orangeville for a term of three or five years. The contract with the present company expires on the 21st of October, 1894. Further information can be obtained from the undersigned, also specifications and form of tender.

The lowest or any tender not necessarily accepted.

JAMES MORRISON,
Chairman Street Lighting Committee.
Orangeville, August 21st, 1894.

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General electrical supplies	4,574.35
Electrical apparatus in course of construction, and wire	10,145.17
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Stock in machine shop	3,140.93
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Machinery	5,695.20
	$26,763.60
REAL ESTATE—	
Two-story brick factory and 1¼ acres land	8,000.00
Total	$34,763.60

TERMS—25 per cent. cash, and balance can be arranged with the Assignee.

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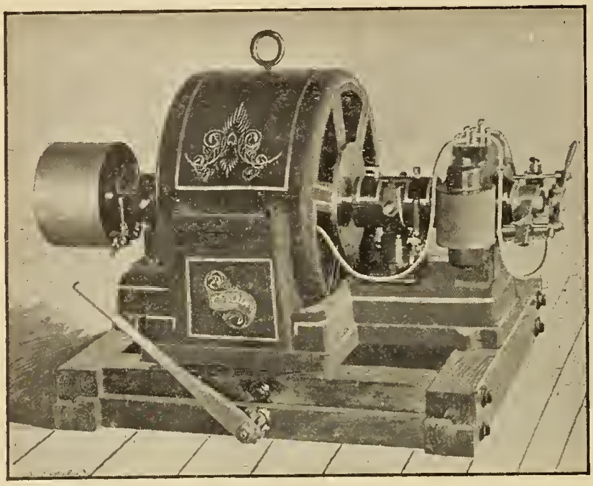

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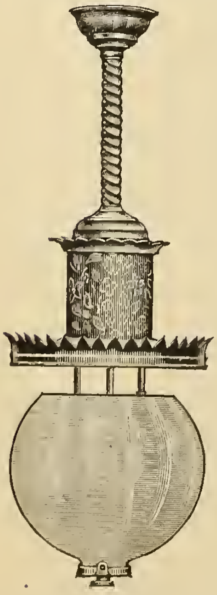

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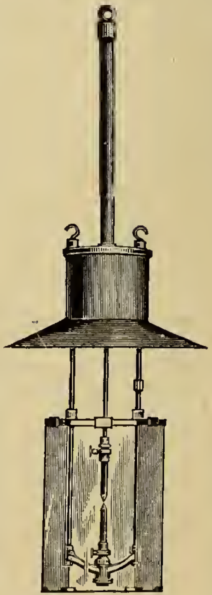

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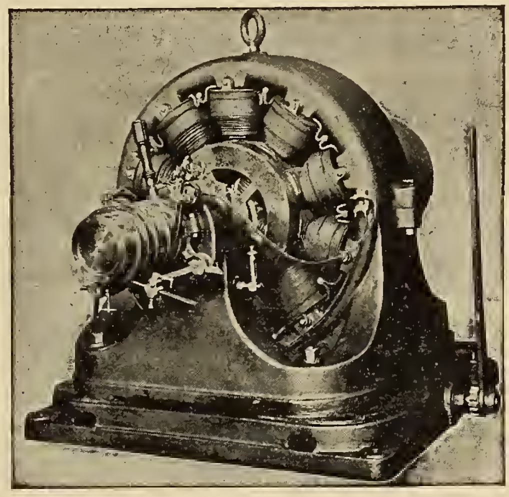

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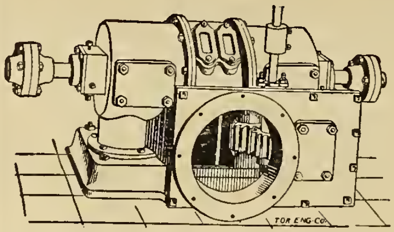

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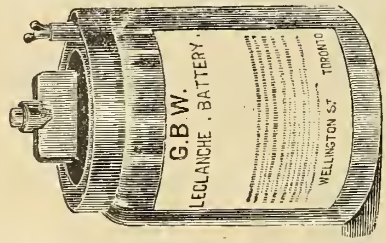
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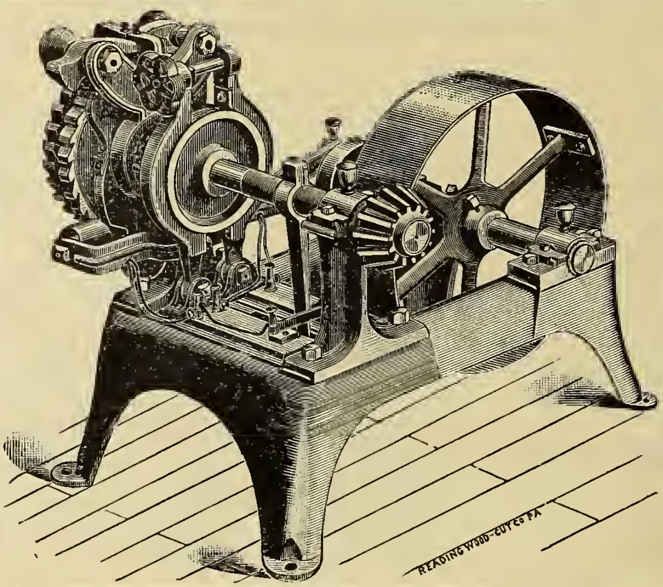
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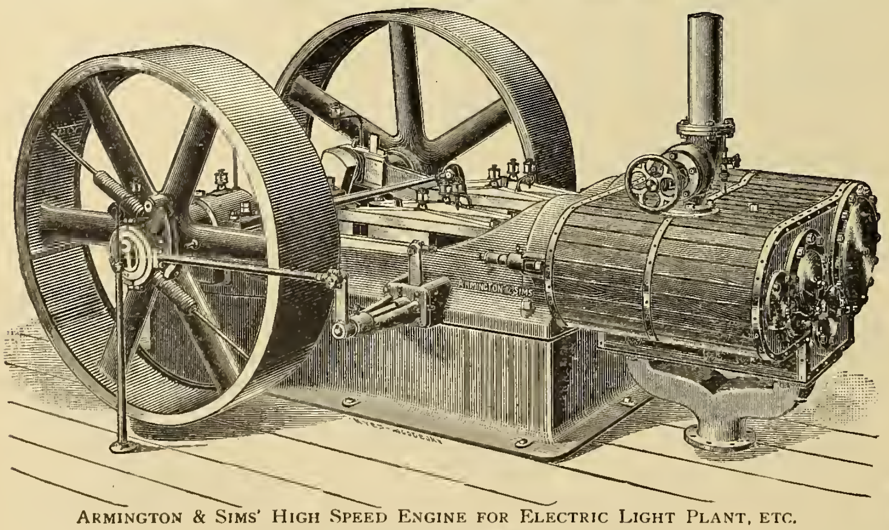

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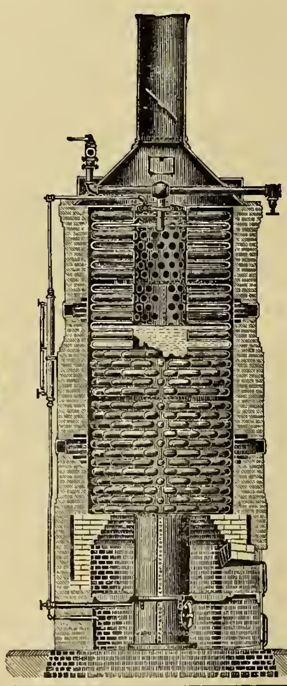

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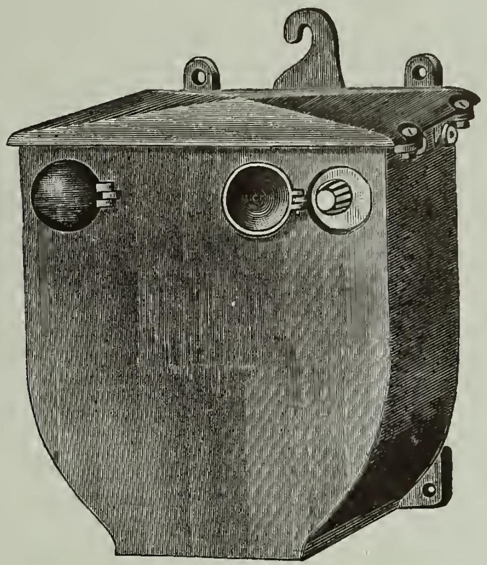

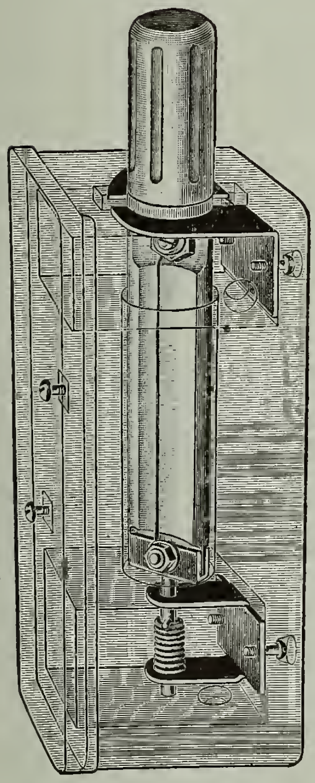

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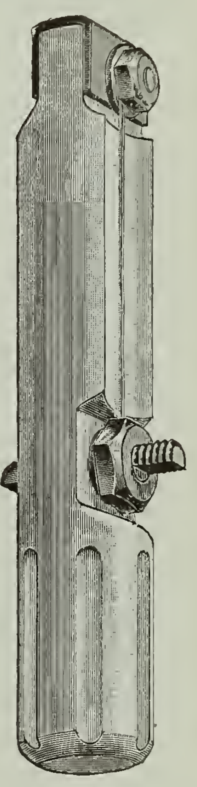

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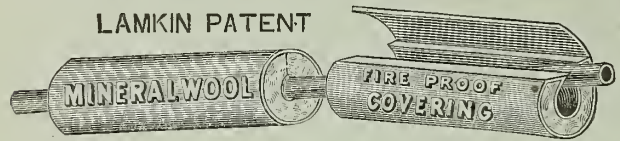

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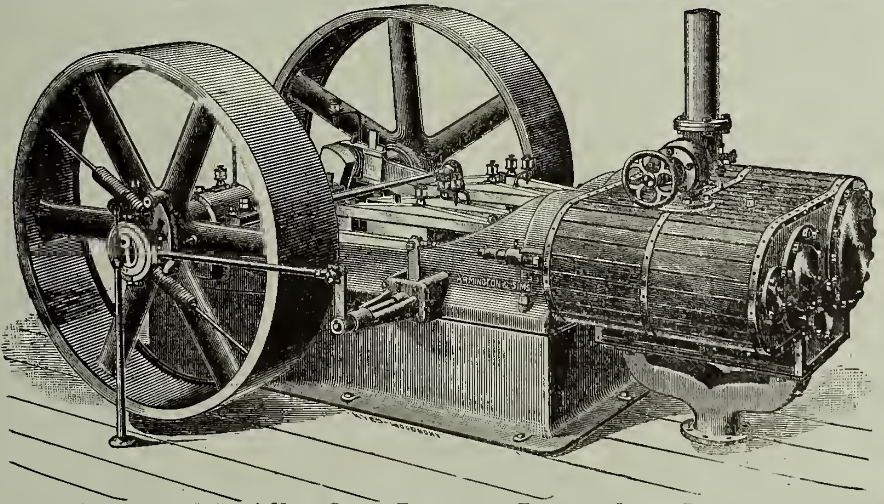

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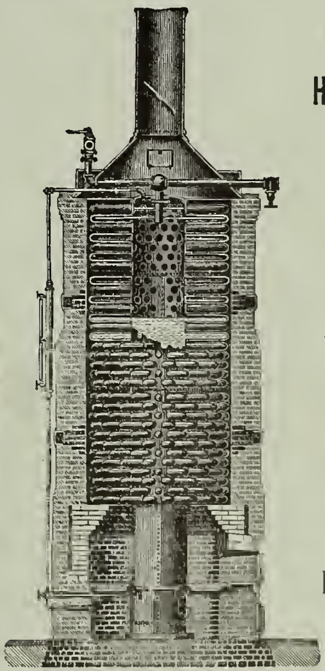

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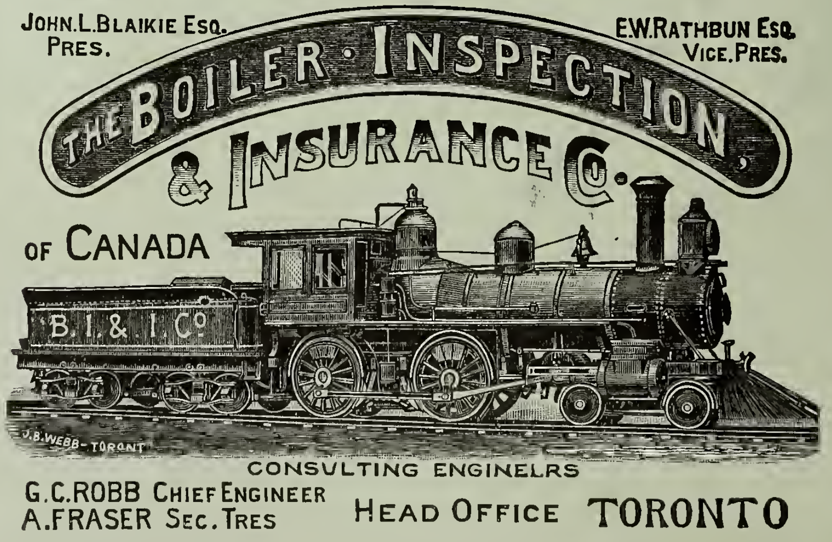
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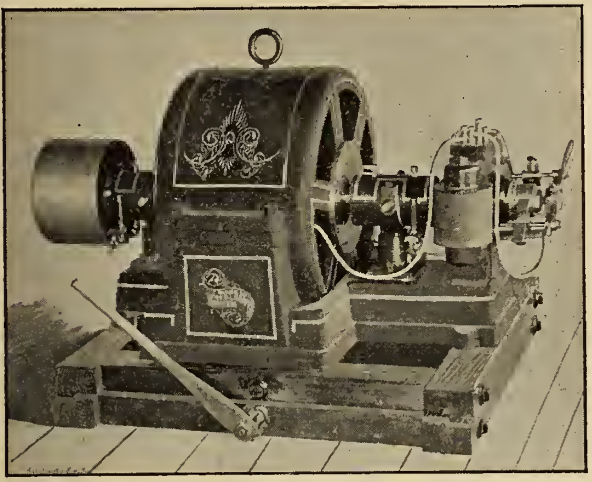

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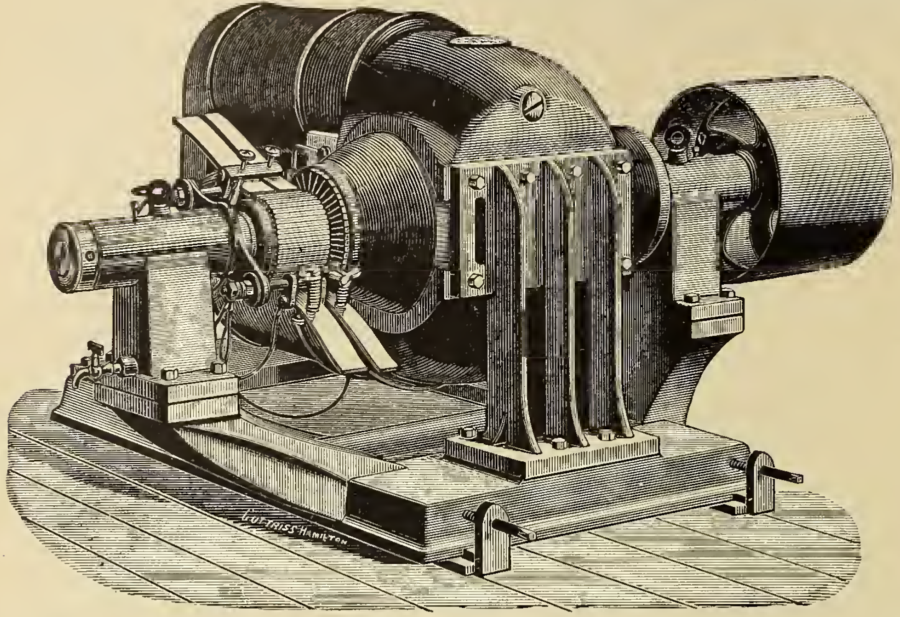

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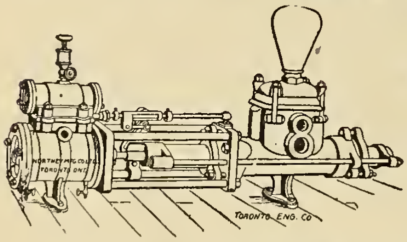
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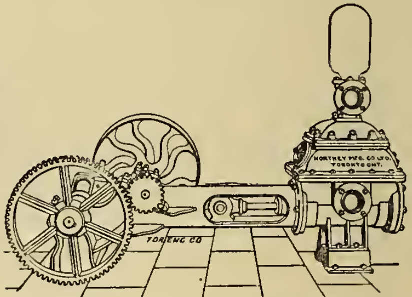
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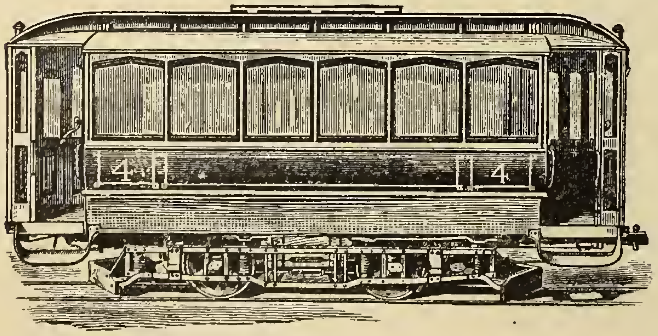

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CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. IV. OCTOBER, 1894 NO. 10.

CANADIAN ELECTRICAL ASSOCIATION

PROCEEDINGS OF THE FOURTH CONVENTION.

THE fourth convention of the Canadian Electrical Association opened in Room 310, Board of Trade Building, Montreal, at 11 o'clock a.m. on Wednesday, Sept. 19th, 1894. Mr. J. J. Wright, the President of the Association, occupied the chair. Among those present were the following :—

L. B. McFarlane, W. B. Shaw, John Carroll, D. A. Starr, Fred. Thomson, G. W. Sadier, Geo. M. Wight, Hial Brown, Chas. C. Paige, W. G. Slack, Robt. F. Jones, W. B. Powell, F. W. Atkinson, E. B. Biggar, Geo. H. Hill, Jas. Hunter, Jas. Geen, Montreal ; K. J. Dunstan, A. B. Smith, C. H. Mortimer, W. A. Tower, T. R. Rosebrugh, John Langton, Wm. Bourne, J. A. Baylis, A. M. Wickens, J. C. Gardner, Geo. White Fraser, Toronto ; J. E. Brown, D. H. Keeley, O. Higman, C. F. Medbury, D. C. Dewar, Ottawa ; W. R. McLaughlin, New York ; Geo. Black, W. F. McLaren, Robert Dickinson, Hamilton ; J. W. Taylor, W. P. Roper, Peterborough ; A. A. Wright, C. H. Wright, W. A. McKay, Renfrew ; R. G. Moles, Arnprior ; Chas. A. Bissett, St. Johns, Que.; E. Carl Breithaupt, Berlin ; Chas. F. Ernst, New Hamburg, Ont.; John Yule, Guelph ; J. M. Campbell, Kingston ; Andrew E. Sangster, Sherbrooke.

Mr. Thomas D. Lockwood, Advisory Electrician of the American Bell Telephone Co., Boston, and Mr. F. S. Francisco, President National Electric Light Association, of Rutland, Vermont, were among the visitors.

The chairman in opening the meeting said : I may express the pleasure it gives me to meet the large attendance present at this the opening session of the Convention. I am glad to see we have some of the electrical fraternity with us from the United States, and am happy to give them a most hearty welcome, and at the same time I might mention our meetings are open, and we will be glad to have our visitors take part in the discussions that are expected to take place on the reading of the various papers. I have to congratulate the Association on the papers we have had prepared by a number of our members.

The Secretary then read his annual report as follows :

SECRETARY-TREASURER'S REPORT.

In view of the exceedingly full programme which awaits your attention, I am reminded that I should make this report as brief as possible.

The Association year, which closed on the 31st of May last, was a comparatively uneventful one, apart from the Convention held in Toronto a year ago, which was admittedly the most interesting and enjoyable of any that had been held up to that date, but which I trust will be eclipsed by this in which we are now assembled.

Three meetings of the Executive Committee have been held since the last convention. At the first of these, which took place on the 24th of November last year, payment was ordered of the accounts in connection with the Convention, the details of which are given in the Treasurer's report ; several new members were elected ; on motion of Messrs. Black and Smith it was resolved that new members joining the Association in the interim between two annual meetings will be entitled to membership until the close of the ensuing annual meeting, at which time their membership fees shall again become due.

At an Executive meeting held in Toronto on the 15th of May, Mr. W. B. Shaw was elected a member of the Executive Committee in the stead of Mr. D. Thomson, whose removal to the United States rendered necessary his withdrawal from the Committee. The preliminaries in connection with the arrangements for the present Convention were considered and the Secretary instructed to invite papers from the following gentlemen :—Messrs. Rosebrugh, Breithaupt, Parker, Shaw, Galt, Medbury, Langton, Schwartz, Baylis, Pinolet, Fred. Thomson, Keeley.

At the final meeting of the Executive held on June 25th, the consent of all but three of the gentlemen invited to prepare papers was received. Messrs. Parker, Thomson and Medbury felt compelled to decline. It was decided that the Convention should be held in the building in which we are now assembled, and that the Montreal members of the Executive, the President and Mr. Kammerer be a Committee to complete arrangements. On motion of Mr. Dunstan a sum not exceeding $100 was placed at the disposal of the Committee for expenses.

Subsequent to this meeting the offer of a paper was received and accepted from Mr. Elmer A. Sperry, of Cleveland.

You will I am sure be quick to recognize the value of the papers which are to be submitted at this meeting, and the obligation under which the Association is placed to the authors, who, I am personally aware, have sacrificed time and comfort in their desire to advance the interests of the Association.

The number of active members at present on the roll of the Association is 99, and of associate members 38.

The suggestion has come from a number of our members that a reduction should be made in the active membership fee. It is thought that the effect would be to increase the number of members. The suggestion will no doubt meet with proper consideration at this meeting. It is hoped that as a consequence of this Convention heing held in Montreal, which is recognized as the electrical center of Canada, the Association will receive many additions to its membership, especially from the ranks of the local Electric Clubs, and the Societies of Civil and Stationary Engineers.

The following is a statement of the receipts and disbursements for the Association year ending 31st May, 1894 :—

Receipts.

Cash on hand, June 1st, 1893		$ 6 30	
Cash in bank, " " "		97 18	
63 active members' fees		315 00	
26 associate members' fees		52 00	
J. M. Campbell, to cover exchange on cheque		15	
Ladies' tickets to Niagara Falls		8 00	
			$478 63

Disbursements.

Expenses of Convention at Toronto,			
Lunches at Cliff House	$27 50,		
Dinner on Chicora	27 00,		
J. A. Kammerer expenses incurred for Association	4 35,	58 85	
Reporting proceedings of Convention		26 80	
Grant to Secretary		25 00	
Postage		27 00	
Printing and stationery		65 00	
Receipt book		25	
Exchange on cheques		75	
Refund to W. A. Green for dinners at Cliff House		1 50	$205 15
			$273 48
June 1st, 1894.			
Cash on hand		$ 23 30	
Cash in Merchants' Bank		250 18	$273 48
Total cash on hand, June 1st, 1894			$273 48
Receipts since June 1st, 1894.			
7 active members' fees		$ 35 00	
3 associate members' fees		6 00	
Capt. Carter		2 50	
D. Robertson		1 00	
		$44 50	
Expenditure since June 1st, 894		17 04	27 46
Total cash on hand, September 18th, 1894			$300 94

C. H. MORTIMER,
Secretary-Treasurer.

Audited and found correct—Sept. 19, 1894.
D. A. STARR } Auditors.
L. B. McFARLANE }

Moved by Mr. McFarlane, seconded by Mr. A. B. Smith, that the report be received and adopted. Carried.

There were elected ten active and five associate members.

Mr. J. J. York, President of the Canadian Association of Stationary Engineers, read an address of welcome from his Association to the members of the Canadian Electrical Association.

The President for the Association thanked Mr. York for the kind welcome from the C. A. S. E., and extended to that Association an invitation to take part in the deliberations of the Convention.

Mr. York thanked the President for his kind invitation to the Stationary Engineers.

Mr. Dunstan : Before calling on the committees to report, Mr. President, I want to call attention to the fact that we have with us Mr. Thomas D. Lockwood, of Boston, Mass., the Advisory Electrician of the American Bell Telephone Company, whose name is well known to almost every member present. He is one of the eminent electricians of America, a walking library of electrical knowledge. I find in Article 3 of our Constitution we have the power to elect by a two-thirds vote honorary members. So far we have never exercised that power. I have much pleasure in proposing that Mr. Thos. D. Lockwood be the first honorary member.

Mr. John Carroll seconded the motion, which was carried unanimously.

Mr. Lockwood : Mr. President and members of the Association—For the first time in my life my breath has been taken away by the action of my brothers. It is a great pleasure to me, indeed, that in my travels in search of recreation I happened to reach Montreal on the occasion of your meeting here, and I feel it a great privilege and honor, not simply to be made an honorary member of your Association, which in itself is a great honor, but to be actually the first one. When my friend Mr. Dunstan nominated me just now, mentioning that I was a walking library, the word library was indeed a great relief to me, for when he spoke I thought he was going to say I was a walking delegate, which I assure you I am not. (Laughter and applause.) I must congratulate you on the eclecticism of your programme. Until a few years ago the knowledge possessed by physicians and medical men as to the application and use of electricity was largely of the negative kind. That is so no longer, and it is a matter, I think, that the entire fraternity may rejoice in, that medical electricity is made equally important with every other branch of the applied science, and looking over your programme it seems to me that the papers which we are about to hear read will be of great use to every one of us, and I trust on behalf of myself, as well as on behalf of the members about me, that the discussions will be considerable and that each paper will be thoroughly and practically discussed. I once more thank you for the honor you have conferred upon me. (Applause).

GENERAL BUSINESS.

It was moved by Mr. K. J. Dunstan, seconded by Mr. A. B. Smith, that the word "five" in the second line of Article 5 of the Constitution be struck out and the word "three" substituted, and that this reduction in active membership fee date from the 1st of June, 1894, the Secretary being instructed to refund two dollars to all members having paid $5 for yearly subscription from that date.

Mr. Dunstan read from Article 9 of the Constitution referring to this point.

Mr. E. Carl Breithaupt moved, seconded by Mr. Kammerer, that Messrs. Smith, McFarlane and Dunstan be appointed a Committee to take the matter in hand. Carried.

Moved by Mr. A. B. Smith, seconded by Mr. Kammerer, that all previous committees be dispensed with, and that committees be nominated by the President on Legislation, Statistics, and Constitution and By-laws. Carried.

The President read a communication from Mr. Cunningham, Chief Engineer of the Montreal Street Railway Co., extending an invitation to the members to visit the power house of the company.

It was arranged that a visit should be made there at 2 p.m. on the following Friday.

The President read a communication from Mr. Paige, manager of the Packard Lamp Co., inviting the Association to visit the Queen's Theatre this evening.

At twelve o'clock noon the President declared the meeting adjourned to 2 p.m.

AFTERNOON SESSION.

At 2 p.m. the President took the chair and called the meeting to order. He then appointed the following committees:

On Statistics—Messrs. E. Carl Breithaupt, Berlin; John Langton, Toronto; John Galt, Toronto.

On By-laws and Constitution—Messrs. J. J. Wright, J. A. Kammerer, A. M. Wickens, A. B. Smith and K. J. Dunstan, all of Toronto.

On Legislation—Messrs. J. Berkeley Powell, Ottawa; L. B. McFarlane, Montreal; John Yule, Guelph.

These nominations being put to the meeting, were adopted.

The President called upon Mr. W. B. Shaw, of Montreal, to read a paper on "The Application of Electricity for Medical and Kindred Purposes from Light and Power Circuits." Mr. Shaw illustrated his paper with a transformer. (See page 125.)

Mr. Black: I have listened to the paper read with great interest. There is one point which the reader of the paper did not make clear which I would like to have cleared up, because it would not do to go to the public as the opinion of this convention that this current used by doctors is perfectly harmless or is without danger. About fifteen months ago I read a discussion in the Electrical World on this subject, and I agree with Dr. Waite, who took the ground that it would not be right for a doctor to employ a current coming from outside, because a wire might come into contact with a current of fifty or one hundred volts, or possibly come in contact with a thousand or two thousand volt wire. The person who took the other side of the discussion suggested that a fuse would remedy that, but we must bear in mind that a fuse takes time to act and the mischief would be done before the circuit would be opened, and on the other hand a sudden opening of the circuit is sometimes dangerous to the patient. The view of the writer of that article was that it was both dangerous to the doctor and dangerous to the patient, and that no doctor should take such a risk upon his hands. When we consider also that others besides educated medical men are dabbling in these things, if it became known that everybody who liked could dabble with the current that comes into his house, it would be rather dangerous. I would like if Mr. Shaw could tell us what precautions should be taken in such cases as that. He simply gives a few words: "A broken wire would cause the patient to receive a violent shock, which in internal examinations might prove fatal. A worse objection is, however, open to the straight current brought in from outdoors, viz., contact with a higher tension wire."

Mr. Shaw: In regard to that question I do not see any means or method by which the current can be made absolutely safe. The danger from a falling wire always exists. I do not know of any way by which that could be got over.

Mr. Black: The proper way would be to use a generator.

Mr. Keeley: Did you say your method was to put in a transformer, Mr. Shaw?

Mr. Shaw: Yes.

Mr. Keeley: In that case you would have a low tension. It would be altogether independent of the outside current.

Mr. Shaw: Yes, I would in that case.

Mr. Lockwood: It seems to me that the Association owes a great debt to Mr. Shaw for giving such a practical paper on a rather unusual subject, and a subject with which perhaps most of us who are engaged in the other practical applications of electricity are less familiar than any other, and I for one will gladly own my debt to Mr. Shaw. I have been instructed by this paper, and I desire to express my pleasure as to the information I have received from it. I have a particular sympathy with the remarks of the paper concerning the dentist's chair, because I have been there myself, both as a practitioner and as a patient. In my early years I could not find anything else to do at one time, and therefore undertook the post of a journeyman in a dentist's office in Port Hope, Ontario. I remember when the dentist had poor patients come in who he did not think were worth fifty cents, he would turn them over to me at twenty-five cents to practise on. (Laughter.) And we had no electrical appliances at that time worth being called such; in fact, the only practical utilization of electricity then was telegraphy, unless I except, of course, the making of electrotypes and electro-plating with which we were very unfamiliar indeed. But at the present time the dentist's work has been made comparatively easy to the practitioner, and comparatively painless to the patient. I say comparatively, because I think even now with all the improvements which art and science have been able to give to the dentist, it is still a matter of dread to the ordinary man or woman to sit in the dentist's chair even to have teeth filled, much less extracted. With regard to the hair brushes which Mr. Shaw has honored with a mere mention, I would like to say that I have found that with you as well as with us the charlatan is still abroad in the land. Almost the last thing before I left Boston I had occasion to buy a hair brush and one of the principal druggists in the city earnestly entreated me to take what he called an electric brush, and showed me it was surely electrified because when he waved it over a small pocket compass the needle deflected. (Laughter.) Being an ignorant man I had not sufficient faith in that form of electricity and declined to buy the brush on the endorsement of its being an electrical one, and was foolish enough to buy one with ordinary bristles. I lost that brush, and while I was at Ottawa this week on going into a drug store to buy another I was very much surprised to have the same experience, almost entirely the same. This brush I was entreated to buy was electrical and for the same reason, that by waving it over a compass it made the needle deflect. I have had some small experience in different branches of electricity. One of the most ordinary afflictions with which mankind is cursed is to have little fatty tumors, some people call them wens. Electrolysis applied to this is one of the best and most perfect means of bringing them down, so that they will not have sufficient strength to rise again; I have known many persons benefitted by it. I am specially pleased at seeing this paper advocated, although perhaps not as strongly as it might, the taking of an electric current from mains which are ordinarily intended and used for other purposes. This is especially advantageous where it can be done, for the reason that if you have a voltaic battery, I do not know whether it is not called a Faradic battery here, all the voltage you can get at any time is that found between the terminals of the poles, but if you take current from the main by interposing resistance you can get easily whatever difference of potential you may want, and I do believe, and I hope my belief will be correct, that the time will come, and at no very distant date, when the electric mains will be introduced into many more places than they are now, for industrial purposes, not only those which are the most preferable to use and the most ordinarily used, but also for the many uses of domestic and scientific work, and for this reason that you can regulate your voltage by interposing resistance to any degree you please, and I think we may all bear in mind profitably that that indeed is one of the principal distinctions between the two ordinary terms, "electromotive force" and "potential difference."

It was pointed out by some of the members that all risk of outside contact with dangerous wires could be overcome by using a motor on the street mains connected by a belt with a small generator giving the required voltage for the practitioners' use.

Mr. J. A. Baylis, of Toronto, then read his paper on "Electrolysis," and produced some photos of water and gas pipes, and telephone cables injured by electrolysis in Boston, Hamilton and other cities. (See page 143.)

Mr. Keeley: In one portion of your paper you say "putting the negative to line." And you say later on "the negative pole of the dynamo should be grounded." You also say, "absolute protection as far as is known, it is impossible to have, but to ensure the greatest freedom from destructive action, the track circuit must be of the lowest possible resistance." I presume that you mean that the positive pole should be to line.

Mr. Dunstan: We would like to hear from Mr. Black as to the trouble that has arisen in Hamilton, and whether it has been yet overcome.

Mr. Black: In reference to Hamilton, I know every few days I used to see something in the papers about the water pipes being examined in the City Engineer's office; he has a pile in the corner of his office, but those were the days when they used the old strap rail and the bonds were broken. Those familiar with the position of Hamilton will remember that the main return circuit ran down James street. The single track ran to the power house and York street, King street, Barton street branched off. The whole current had to be returned to this one set of strap rails, and when the strap rails were worn the bonds broke, and the current would get off some other way. Since they have laid the new rails and made their bonding I believe there has been no complaint. All the pipes taken out were in the neighborhood of, and not very far from the power house. I believe they were not found injured in any other place than in the neighborhood of the power house. The City Engineer has gathered quite a mass of information, and I intended calling on him to see if he could give us anything on the subject for this meeting but I heard he was not present at his office. But I think everything is changed there now, for I understand the railway company have now connected the main water pipe with their ground wire at the power house and that reduces the chances of further trouble. I move a vote of thanks to Mr. Shaw and Mr. Baylis for their very instructive papers.

Mr. Shaw: In regard to the remarks as to the electrolysis being occasioned by the polarization of gases, that would cause an even wearing away of the pipes right along, but there is not an even wear.

Mr. Keeley: I think it would be found that wherever there was a marked effect on the cable, the ground would be very moist at that point. I think it would be found surrounded by water. Here is a piece taken from the vicinity of the power house in Hamilton and it looks as if it had the small-pox, and it has evidently been in water. Possibly the water may have passed through a limestone formation. I think it would be well for the members to keep in mind to note particularly the condition of the spot from which the specimens are taken.

Mr. Lockwood: The subject of this paper is one of great importance to many classes of people. It is of great importance to City Engineers because they have control of gas and water pipes, at least they ought to have if they have not. It is important to the telephone man, and it is important to the railroad man, because he naturally does not want to interfere with other people's belongings any more than he can or must. Then it is of importance generally because we ought to know and we want to know all about the working phenomena of electricity that we can know, in order that we may perform our own work properly. There seems to be one thing further that paper might have mentioned and did not, and that is, that a great deal of this electrolytic corrosion of underground cables is dependent on the amount of electricity that is pumped into the earth within a given area of space. Now, I suppose the most noticeable instance of this kind of thing is that which has occurred in Boston. Many of you, certainly all of you who are concerned in street railroading, know that there is the largest installation of electric street railway in the world, and it is needless to say that there the largest currents are brought back to the dynamos through the earth: larger than anywhere else. I was a little surprised in learning that the paper says that one of the remedies, the first remedy that has been suggested and tried, is grounding the positive pole at the dynamo and putting the negative pole to line. I wish to do them justice by saying that they have showed themselves always ready to try any experiment which persons conceiving themselves electricians have suggested, to prevent the electrolytic corrosion of underground cables. It is my memory that the dynamos of that company ordinarily have their negative pole to line, and that it was not until their attention was called to the fact that they changed it and put the positive pole to line. With the negative pole to line (and this again is entirely a question of memory), with the negative pole to line, so large is that system and so enormous are the amounts of electricity delivered to the earth after passing through the trolleys and the motors, that the electrolytic corrosion of pipes and cable tubes was in all quarters. In fact, it spread nearly all over the city, and it seems to me that it was as a suggested remedy that the present method has been adopted, in which the positive pole of the dynamo is to line, and while it is not a remedy, still it is a change which is mentioned in the paper, in a kind of negative way. It does restrict the trouble to a small area immediately around the power station, and when it is restricted to such a small area it is much more easily handled than a corrosion distributed around a large city. In addition extremely large copper cables are used. In Boston, copper cables of more than one inch in diameter have been employed, to aid the rails in returning the trolley current, and the trouble is very largely minimized. I personally do not think that in small installations of electric railroad serious trouble need be expected, but I think in large cities it is to be expected, and every remedy that can be thought of, provided it is proved to be at all efficacious, should be effected. The bonding of the rails, as suggested, is no doubt one of the principal things that is required. I do not think that the electric welded rails have, to any great extent, gone into use yet, and I think the unwieldliness of handling them will be an insuperable objection. But, with the best conductors that are made, we have still to remember that the old doctrine that used to be promulgated, that electricity would choose only the best path, must be discarded, not only from our lips but also from our thoughts, and remember that electricity avails itself of all paths in proportion to their respective resistances; and when we think of that, we cannot help but see, no matter how perfectly our roads are constructed, we should make the return conductor as perfect as it can be, and it is still the best thing to have the positive pole of the dynamo to line, and to aid the rail in the vicinity of the dynamo and of the power house by very large copper conductors.

Mr. Baylis: That remedy was suggested in an article issued in one of our papers in July of this last summer, as having been tried in Marseilles, in France, and it was strongly recommended there. They grounded the positive pole and had the dangerous area distributed over a large portion of the town, and they were experiencing no trouble, and this was commented on in an editorial in the London Electrician. It was stated, however, that it was not a true remedy.

Mr. Medbury: In Ottawa I had some experience with the Engineer of the Bell Telephone Co. in taking some readings of the different potentials between our rails and the ground, and after looking up the matter carefully we believed that by taking readings at different points, different manholes, we could simply connect the cables to the rails where there was the greatest difference potentially, or make the connection between the rail and that portion of the telephone cable which came nearest the power house, and in that way, of course, assuming always that the cable is positive regarding the rail, do away with pretty nearly all the effects of any electrolytic action. In a small city that would entirely remedy the matter, I think. In that case I would have the positive pole of the machine to the trolley wire. Of course our station there is located some way from the centre of the telephone cables, and unfortunately we could not measure the amount of current flowing on the cables. We did not much more than find out where the greatest action was going on, but of course, with a careful test, we could find out how much current was flowing, and whether it was bunched, or where the greatest tendency was to leave the cable.

Mr. Baylis: In Toronto, in the westerly portion of the city, the potential difference is three volts. Taking the opposite side of the city, it varies from two and a half to four volts. And there is a gradual decrease from the three volts in the west to about zero in the centre, and gradually increasing to about four in the east.

Mr. Shaw: Which pole does the trolley wire connect with?

Mr. Baylis: To the positive. And the current we get off the cables, measuring from the cables in our easterly manhole, the manhole nearest the power house, to the water main which is in the manhole, is eleven amperes.

Mr. Medbury: The potential difference between those cables and the rail does not mean anything unless you take the amperes along to make a reading of.

Mr. Baylis: I think the potential is the most important thing because, in the case I have been speaking of, I can measure the number of amperes flowing from the cable to a given point, at the junction of a water main in a manhole, we can get a large amperage. The measurements that may be taken on any pipes, either cables or water or gas pipes, with an ammeter and volt meter, are generally valuable in showing the direction in which the current is flowing. It is impossible to measure the number of amperes running from one point to another unless you can insulate the pipe entirely from the ground through its entire length. You are simply taking the alternative path of the current, as it were.

Mr. Medbury: Potential difference is not what is doing the damage. We get a very low potential difference, but get a considerable current on the pipe. You can find out a cable is carrying a certain amount of current by fastening on to that cable and conducting it back to the rail or any other circuit.

Mr. Baylis: Well, if you take the readings of the ammeter, taking a gas or water pipe, for instance, which is buried in the earth, and expose the pipe for seven or eight feet and put an ammeter between the pipe and the ground, you probably will get a very small current flowing. At the same time a great deal of current may be flowing from the pipe to the ground. The The current is leaving the pipe all right enough, but it is not going through your ammeter.

Mr. Medbury: I can see your point. My point, as I have understood it, and my experience in the matter is this, that taking two streets, (this is how the case stands) two parallel streets, and this cable runs down one street and the electric railway is on the other street, but as there is a current going up to the farther street it takes just a short cut over that cable, and the whole of that current is going down that cable. It branches off the street and makes a conductor for it. If the cable happens to turn three or four streets down there, the current is leaving the cable again. Of course, if you take it at that point and put a tap on, you are not getting any electrolytic action at all. The cable simply acts as a conductor for the twenty or thirty amperes that happen to be flowing over it. Of course, after you have got away 100 feet from that corner, perhaps there would be no current to speak of flowing around the outside of the cable; it would all be going over that cable, perhaps twenty amperes. Of course readings taken anywhere inside of that zone of electric current would give various readings according to the position at which you are taking the readings, but twenty feet from the corner you have quite an number of amperes running over the cable.

The President called on Mr. L. M. Pinolet, of Montreal, to read a paper on "Alternating Current Motors." (See page 126).

Mr. Medbury, in discussing the paper, said: This is a very interesting paper and contains a great deal of information in a small space. I was much interested recently in watching the operation of starting synchronous motors by the currents induced in special closed circuit windings on the fields. When synchronizing speed was attained, the field circuits were connected with the proper current and the motors then ran synchronously. The fact that the speed of a synchronous motor depends upon the rate of alternation of the exciting current, does not appear to be universally comprehended, for I recently received a communication from a person to whom I had supplied one of these motors, asking how to reduce his speed and saying that he has considerable resistance in circuit with the motor to lessen its speed, but without affecting the speed at all.

Mr. Brown: I would like to hear something further on this subject as I understand considerable trouble has been occasioned by the false currents due to the self induction of the motors flowing back through the transformers, the line and the generators. I understand this has caused considerable trouble and condensers have been used with the motors to overcome it, but have been found to be objectionable.

Mr. Pinolet: Many of the early polyphase motors were not well designed and were inefficient, but with a well designed motor the loss due to self-induction is trifling. Dr. Louis Bell in his recent paper to which I have already referred, published a comparative test of the current of a polyphase motor and that of a continuous current motor of the same capacity at different loads. His tests showed that false currents were only noticeable in the polyphase motor at very low loads and at overloads. Between these limits, the currents taken by the motors were substantially the same.

Mr. Medbury: If there is no further discussion on this paper, I would like to present something which may be of some interest to those who are in the same line of business as I am. We are often asked regarding the relative cost of transmission for any long distance transmission plant at say 2,000 volts without step-up and step-down transformers and say 5,000 volts with step-up and step-down transformers. I made up a little equation which I will hand in because I think it may be useful, as I only recently ran across a case where there was a transmission of two and a half or three miles and the parties were strongly urged to use 5,000 volts with step-up and step-down transformers. It is hard work, and takes considerable time to figure the thing out without an equation in black and white. Of course there will be a certain distance at which the cost of the wire for the 2,000 volts will equal the cost of the wire for the 5,000 volts plus the cost of the step-up and step-down transformers. For a distance beyond this point, transmission at 5,000 volts with step-up and step-down transformers will be cheaper, and for a shorter distance which does not reach this point, transmission at 5,000 volts will cost more money than at 2,000 volts.

An equation to determine the distance at which the cost of transmitting any given power electrically is equal, whether a lower voltage is used without raising or lowering converters, or a higher voltage is employed, using raising and lowering converters, may be of interest to those who are frequently asked to decide between the two methods of transmitting power any given distance. The following equation, which seems to be useful for this purpose, is offered :—

$$d = \left\{ \frac{1}{ck} \quad \frac{bB(T+G-)}{aB-Ab} \right\}^{1/2} \qquad \text{where}$$

d = Distance in miles at which costs are equal.
a = Amperes on lower voltage line.
A = " " higher " "
b = Volts lost on lower voltage line.
B = " " " higher " "
c = Cost of copper wire per pound.
k = a constant 3950.5.
T = Cost of transformers for higher voltage line.
G = Extra cost (if any) of higher voltage generator over lower voltage generator.

A study of the equation shows that for any assumed values per unit of size of transformers, d is independent of changes in A or a, that is, the distance does not vary with the power to be transmitted, but varies inversely as the square root of the cost of copper, and directly as the square root of the cost of transformers, and as the drop in volts where the per cent. of loss taken is the same for both systems, or in other words, d varies very slowly for changes in B, b or T. As an illustration of the use of the equation, let us determine the point at which, for transmitting the same amount of power, the cost of a 2000 volt installation, without raising or lowering converters, equals the cost of a 5000 volt installation using first a 5000 volt machine and lowering converters and then a lower voltage machine and both raising and lowering converters. Let A = 1. Then for the same power transmitted a = 2.5. Let the loss be 16⅔%, then B = 1000 and b = 400. Let the cost of bare copper wire be 14c. and raising or lowering converters cost $20 per K. W. Then in the first case T = 100 and in the second 200, say G = 0. Substituting these values in the equation we have

$$d^2 = \frac{1}{.14 \times 3950.5} \quad \frac{1000 \times 400 \times 100}{2.5 \times 1000 - 1 \times 400} = 35.7312 \text{ or}$$

71.4624 when raising and lowering converters are used with a lower potential machine. Now $\sqrt{35.7312} = 5.98$ and $\sqrt{71.4624} = 8.45$, which shows that under the conditions assumed for transmitting any given power up to 5.98 miles, a 2000 volt installation costs less than a 5000 volt installation with a 5000 volt generator and step down transformers; beyond that distance the 2000 installation costs more, and when both raising and lowering converters are used this distance is increased to 8.45 miles. It should be noted, however, that this distance as already shown depends upon three factors, the assumed cost of copper, the loss on the line and the cost of raising and lowering converters.

An equation which enters into the above equation may also be of interest, as it determines quickly without the need of a circular mils table the total weight of wire required for any power transmission. It is

$$\text{weight of copper} = 3950.5 \, \frac{a \quad d}{\text{volts lost}}$$ where a and d are as above.

These equations are based upon 10.7 ohms as the resistance of a mil foot, and five per cent. has been figured for sag allowance.

The chairman asked Mr. Medbury if he remembered having at the last convention made some reference to distribution by polyphase currents for light and power that was to take place at Rochester and asked if he had any particulars as to how it was operating.

Mr. Medbury said there were three machines in operation there at the present time. They were combined continuous and alternating current generators, each giving at one side two-phase alternating currents and at the other side continuous current, so that at the same time both continuous and alternating currents could be obtained from the same machine. It is a commercial system with alternating current motors operating successfully by two-phase currents. At Concord there is a three-phase plant and three-phase motors in successful operation.

Mr. Brown: Are these motors synchronous or non-synchronous motors, and are condensers used?

Mr. Medbury: They are non-synchronous motors in both cases, and are operated without condensers.

Mr. Medbury requested, as Mr. Higman, of the Government Inspection Department, was present, that he should speak to the meeting on the position the bill in relation to electricity was in.

The chairman said it was very short notice for Mr. Higman, and requested that gentleman to present the situation at the following session of the Convention.

It was moved by Mr. A. B. Smith, seconded by Mr. H. A. Brown, that the thanks of this meeting be tendered to Mr. W. B. Shaw, of Montreal; Mr. J. A. Baylis, of Toronto, and Mr. L. M. Pinolet, of Montreal, for the instructive papers they have given this afternoon. Carried.

Mr. A. B. Smith reported that the Committee on Membership Fees recommended that the fee for active membership be reduced to $3.

Mr. K. J. Dunstan, in speaking of the report, said: It is a reduction in the membership fee from $5 to $3. The reason I make the motion is simply this: By the Treasurer's report we have on hand about $300; the cost of the last convention was in the neighborhood of $200; that means we have a surplus of about $100, after paying the expenses of this convention, assuming they are approximately the same as last year. We have also all the fees which will become due for the current year. The Canadian Electrical Association is not a money-making institution; we simply desire to pay our way. We fixed the fee at $5 with the view of being sure we could pay expenses. Having found that we can now reduce it to $3, I think it is in the interest of the Association that the reduction be made. We want members more than than money. We have no debt to pay off; we simply want to make ends meet. I think probably if there is only a difference of a dollar between the associate membership fee and the active membership fee, nearly all of the associate members who can qualify will become active members, and take part in all the proceedings of the Association.

The President: I think those remarks are all right, provided the members all pay up. Quite a number of the members are in arrears for their last year's subscription, but I presume if the amount is made less there will probably be less difficulty in collecting it.

The motion being put to the meeting by the chairman, was carried.

A letter from R. J. Corriveau, of the Montreal Park & Island Railway Co., extending an invitation to the Association for a trip over the suburban line to Sault au Recollet, was read.

The President announced that owing to the unfavorable weather the trip down the Lachine Rapids was postponed to Friday morning at 8 o'clock.

At 4.45 p.m. the meeting adjourned.

SECOND DAY.

On the 20th of September at 9 o'clock a.m. the members assembled at the Queen's Hotel and thence visited McGill University, where an investigation was made of the electrical appliances in the Macdonald Building, on the invitation of the Faculty of Applied Science and Prof. Chas. A. Carus-Wilson of the Electrical Department. An inspection of the electrical laboratories was made and a practical test on a transformer of apparatus for the measurement of alternating current power given by Professor Wilson.

At 11 a.m. the President called the meeting to order in the Board of Trade Building and stated that Mr. Higman of Ottawa would in the afternoon give an explanation of the working of the Inland Revenue Department as to testing electric meters.

Mr. A. B. Smith moved, seconded by Mr. McFarlane, Resolved that the hearty thanks of this Association be tendered to Prof. Chas. A. Carus-Wilson of McGill University for the elaborate and extremely interesting exposition of the electrical testing apparatus in use in the University and that the Secretary be instructed to forward a copy of this resolution to Prof. Wilson.

The President put this motion to the meeting and it was carried unanimously.

Mr. E. Carl Breithaupt, of Berlin, read his paper on "Municipal Electric Lighting." (See page 139).

The President then called upon Mr. J. Francisco, of Rutland, Vt., President of the National Electric Light Association of America, to address the meeting, extending to him also an invitation to take part in the discussions.

Mr. Francisco replied :—Mr. President and gentlemen—When I left the United States I supposed I was going to leave the question of "Municipal Ownership" behind me. I did not know I was going to come into it here, and hear the discussion following the reading of a paper on this subject.

I have devoted a great deal of time to the subject of Municipal Ownership, and have received a great deal of cudgeling in my experience on account of the position I have taken. I find almost all over the cry has been raised, not only through the States, but through the Canadian provinces, of the wonderful cheapness with which municipalities can furnish light, but it is pure humbug. It cannot be sustained, and never will be. There is a principle involved that makes it practically impossible for any city to carry it out. When a man who has every ability in the business invests his money in it, can he be compared with a political man, who has no interest whatever except to draw his pay and to help along some political scheme? When it is said a politician can do better than a man who has every ability in the business and his dollars invested, it is nonsense to make such a statement, he cannot do it. (Hear, hear.)

Now, references are made in this paper in regard to some places in the United States that are producing their own lights. At our Convention at Cape May I read a paper on Municipal Ownership which was the first paper read on this subject, and it was the first time we had attacked Municipal Ownership. The head electrician of the electric plant of the City of Chicago was there and he got up and stated emphatically that I was a very broad liar. (Laughter). He said the statements I had made in regard to Chicago were false, that the cost of electric lighting in Chicago did not exceed nineteen cents per light per night. Now, about three or four months ago that same electrician issued a report in Chicago on the cost of electric lights of the system there, and he gave the total expense at $96.64 per lamp per year. That is simply for the lighting expenses, not counting depreciation, interest, taxes, water rent, or anything except the cost of producing light.

In Dunkirk, New York, it was thrown in my face that the total cost of running 107 arc lights was $2200 per year. What were the facts on investigation? No engineer was employed or fireman, and not a ton of coal used at the station. They have an engine there that starts without a man going near it to look after it. The lights start themselves and they trim themselves and everything goes on automatically. That is why it only costs $2,200. (Laughter.)

When you get behind the curtain what do you see? All charged to the Water Department. Every cost of running the lights except the Superintendent's salary was charged to the Water Department. Of course it would only be $2,200. (Laughter.)

The Mayor of Topeka, Kansas, told me personally that when they took the lighting plant from the Company there they guaranteed it should not cost over $64 a year per lamp for the 2,000 candle power lamps. It has cost them $132 per year by actual experience by keeping a record of the running expenses of their plant, and he told me also there was no question but what the city of Topeka could have saved money by hiring lighting from a local company instead of running the plant themselves. They are building it all over and putting in a new thing, the old plant being used up. But they did not charge this; this is an improvement that does not cost anything, that is simply charged up as improvements, and the taxpayers pay it. (Laughter.)

And in Hannibal, Missouri, they had a little bit of a cyclone there which took the top off their power house and everything down to the dynamo, and then they went to repair it. It cost them $1000 odd, and they charged it up to "Construction." It appears now on the city's books as Construction.

In the course of my investigations in this matter I have visited nearly all the stations of municipal plant in the United States, and for the last six months I have had a very extended correspondence with cities and municipalities throughout the Provinces here, and with Toronto. I have been asked questions by officials in Toronto from the Mayor down. It is amusing to read some of the statements made by parties who advocate this municipal idea. You would think it was a perfect Eden in every place where the city owns the plant—it is no expense whatever, the lights are perfect and everything running in magnificent shape. The mayor of Toronto asked me in regard to this same question. In regard to Philadelphia where they had an exhaustive investigation made as to the cost of the plant, three different estimates were made, one by the City Electrician, one by the manager of the city plant, and one by the local companies, all employing outside experts who were supposed to understand their business. And there was a difference between the two estimates of over $150,000 in installing plant. When it came to the running of the plant there was the most peculiar diversity you ever heard of. Of course the electrician was in favor of Municipal Ownership and wanted to show the whole thing in as bright a light as possible. They were going to run 507 arc lights. He did not think it was necessary to have more than one engineer to do the whole business. They were going to start about half past three in the afternoon and run on till the next morning. When he was asked when the engineer was going to clean his engine and look after everything and get some sleep, he said, "Oh, he would do that between those hours." (Laughter.)

The question was asked him how much he expected to pay the engineer to do that kind of work and run it that way. He said he was going to pay him two dollars a day. That is the basis on which he founded his calculation. Where will that go? What is the use of talking in this way to an intelligent electric light man who is experienced and expect he is going to take any stock in that theory.

I have probably travelled over 7,000 miles through the States visiting the plants, and not a single one of them will you find where they can show in one instance that they can produce the light for less than the private or local company can do it under the same conditions and have the same light and get as good results. If you charge all these things to other departments it is very easy to make a small amount, but if you want to produce the light on the same basis, and showing as low expenses, they cannot do it as cheap as the private company can. That has been demonstrated time and again and can be at any time of the year.

Here is another feature : In Canada of course it is not expected that you have anything like what we have in the States. They are all honest here. (Laughter.) The fact is that nine out of ten of the public men who have charge of this business are men you can buy hand and foot. I have had experience of that kind in my own city. Rutland has always been a village until last February. Then they put it in as a city and elected a Council. I do not believe that there has been a single transaction of any kind made in the City of Rutland since that date but what has been boodled. What was the result? They called for bids on city lighting. There was one company there. Another concern from the west came in and made a proposition. The Council gave the contract for lighting to the outside company at five cents per lamp higher than the local company offered. The question is, how much did they spend for boodle? We know they did it as well as if we saw them do it with our own eyes. That is the way that village is run, and that is the way it is run all through the States. You can talk about honesty and integrity in office—you may have it here, but on the other side they do not deal on that basis. But we have some very fine men over there, as fine as you can find anywhere, but the men of character and standing are not in office.

I thank you heartily for your courtesy in extending this privilege to me and trust I shall have an opportunity of meeting you personally. (Applause.)

Mr. A. A. Wright, Renfrew : This speech presents facts and information that every central station man ought to take to heart. If any municipality wants you to undertake to light their streets, the best thing you can do is to say, "No, thank you, I do not want to do it," for it is only a curse to any man as long as he lives. At our town I told the Council a while ago that I would rather deal with five hundred men than with one set of Councilmen. They want you to do the whole thing free gratis for nothing, without being paid a cent for a lot of work they want done, and then have it changed to something else. A central station man cannot do that kind of thing. I say to those who are out of the municipal lighting business, to stay out and not have anything more to do with it.

The Chairman : That is very entertaining for those who are out of it, but it is not much information for those who are in it as to how to get out. (Laughter.)

Mr. Wright : I am in it and I want to get out. I am thinking very seriously of using my dynamos for motors and giving up the electric lighting on the streets altogether ; I think it will pay me better than having anything to do with the municipality.

Mr. D. H. Keeley : Would it be out of the way to suggest that we might set about collecting statistics as opportunity offers, of all the information coming under the notice of members of the Association. It should include facts in regard to the cost of lighting and the difficulties that are actually encountered in regard to dealing with municipal bodies and municipal lighting, and this information should be put on record so it could be sifted out afterwards by the members. The gentleman who has just spoken from the United States tells us there is quite a comparison to be drawn between the municipal bodies of the United States and those of Canada. We can hardly be guided in Canada by the statistics that are furnished from the other side when qualified in that way. If we were able to gather such information in our own communities it would be of great importance. A little while ago in the city of Ottawa the same question came up and there was a great agitation over it, and after a lot of talk it was decided that the companies could do the work just as efficiently as the city could, and the question was left open. The result has been that the companies there have amalgamated and are in a position to give a very excellent service; but that does not dispose of the question at all, and I think if we can, as an Association, put ourselves in the position to get together the information at a future date, it would be of great importance to us.

Mr. E. Carl Breithaupt: This is a good idea. It is a very difficult matter to gather statistics in that way. For the purpose of this paper I have endeavored to get statistics from all the municipal plants in Ontario, and some in Quebec, and have found it very difficult, as half of them would not answer my correspondence at all. I may say the statistics I gathered do not show any better figures than those of the United States published by Mr. Francisco. I have a lot of statistics in my pocket about Canadian municipal plants, but they are somewhat incomplete, and for that reason I did not want to quote them particularly.

Mr. A. A. Wright: I suppose the reason they are not complete is that the people giving them did not know how to do it. These people that are running municipal plants do not know how to do it.

Mr. E. C. Breithaupt: For the benefit of the Committee on Statistics, I would like to say a word on how this committee is to go to work, whether they will be allowed to go to any expense for the Association in the matter, which would almost be a necessity to make the statistics of any value, because just gathering statistics by correspondence like this you cannot get accurate figures.

Mr. Higman: There is another matter, and that is as to standard of power. The Department has received several letters bearing on that subject, asking us to embody in the Bill a standard similar to what was adopted in the United States as to energy.

Mr. J. Langton: In this subject of municipal lighting the point seems to be the business efficiency of municipal government, and it is of interest to know what room for improvement there is. An article was published in the Forum a couple of years ago on municipal institutions in America and England, written by the Right Hon. Joseph Chamberlain, who made his first mark as a public man when Mayor of Birmingham. That city has now the reputation of being the best governed in the world. In the article I speak of he makes a comparison between the municipal expenses of Birmingham and Boston. The populations are almost exactly the same, Boston being 448,000 and Birmingham 430,000. In the article he gives detailed expenditures. The result is that the total cost of municipal government in Boston is twelve millions and a half, and in Birmingham it is two millions and a half; relative figures, five to one. There were some expenditures in Birmingham which were not undertaken in Boston, and vice versa. These related principally to schools and relief of the poor. Excluding these he gets the expenditures for strictly municipal government purposes in Boston a little over ten millions and in Birmingham one million six hundred thousand. The proportion in this case is six to one. Of course Birmingham is a high standard. The last census gives the expenditures of one hundred cities in the United States, ranging in population from 15,000 to 1,500,000, and having a total population of twelve millions and a half, or about two-thirds the urban population of the United States. The cost per head of municipal government varies from $3.79 in Oswego to $27.61 in St. Paul, with an average cost of $16.77 per head, against a standard set by Birmingham of about $4.50 per head, so that if there is anything in these figures, in order to put themselves on a par with private corporations in business efficiency, municipal governments in America must improve till they are about four times as good on the average as they are now. Of course there should be an advantage, if it is properly used, where it is possible to run the electric light in conjunction with water works or other public works, and save some of the general expenses. Whether there is any real advantage from this is a a question for each individual case. In favor of municipal ownership instances are cited of what some one town in one part of the world has thought it profitable to do, as an example of what another town in another part of the world should do. If that is an argument, the city of Geneva, in Switzerland, should be an argument against municipal electric plants. In Geneva the city has developed an extensive system of waterworks and derives a good revenue from water sold for power purposes. But in spite of owning and operating profitably this large system of water and water power supply, they do not seem to think it profitable to supply electric light, although the private electric company gets its power from the city, buying it at a very low figure. I do not think it is much of an argument to assert that an isolated instance in one part of the world furnishes a proper example to be followed by some individual town in another part. But when that sort of argument is used in favor of municipal electric plants, the case of Geneva should be equally valid on the other side.

Mr. Francisco: In answer to the arguments put forward I simply state that the National Association at their last Convention in Washington adopted a standard for our 2000 C. P. arc lights as 10 amperes and 45 volts or 450 watts. That has been adopted by the Executive of the National Association and will be adopted in all probability by the Government.

It was moved by Mr. D. H. Keeley, seconded by Mr. O. Higman, that it would be desirable that steps be taken by members of this Association, to gather and communicate to the Committee on Statistics, any reliable data and information relative to the comparative cost and efficiency of electric lighting by municipalities and by private companies.

Mr. Campbell: In the majority of cases in towns through the the country they do not keep any separate details. The accounts are all jumbled together in one item; power and incandescent lights all from one engine, and it is pretty hard to get at these details unless you go to the man who is at the business and see if there are any books kept and get the details. Any information got in that way, unless it is correct, is worse than useless.

Mr. W. B. Shaw: As the statistics will probably be accepted by the Inland Revenue Department later on, it would be well to sift them, not only in the interest of the Association but of private companies.

Mr. Keeley: It was my intention that only reliable information should be sent in to the Committee. Unless a member could come forward and say, "this is a fact," we do not want the information.

Mr. D. Starr: I think, for the reason that Mr. Higman in his department in looking after and inspecting plants, he or his deputies could gather a great deal of information, and it would be a good thing to have him on the Committee on Statistics.

Mr. Higman: I do not know that the department concerns itself much about statistics except in regard to the number of lamps used, but I will be very glad to do anything I can.

Mr. Keeley: It is not necessary that a man should be on the committee to get statistics together. I said in my motion that it was desirable that the members should communicate to the Committee on Statistics. The committee might consist of one person as far as that goes.

Motion carried.

Mr. Dunstan: Mr. Breithaupt has brought up the question of expenditure in gathering these statistics. I do not think that it is the desire of this Association to incur much expense, but still there will be some necessary expenditure for postage and other things, and the members of the committee cannot be expected to meet it personally. I therefore move that the Executive Committee be empowered to grant from the funds of the Association an amount sufficient in their opinion for the requirements of the Statistical Committee's work in securing statistics. As the work proceeds, and the committee find out exactly what statistics they wish to gather and what the cost is likely to be, the Executive Committee can then consider the matter carefully and grant from time to time whatever sum is required for the work. Seconded by Mr. A. B. Smith. Carried.

Mr. A. A. Wright moved a vote of thanks be tendered to Mr. Breithaupt for his ably prepared paper. Seconded by Mr. Shaw and carried.

Mr. McFarlane exhibited for the inspection of members of the Association an interesting collection of original letters and photographs of celebrities such as Morse, Cyrus W. Field, Vail, Elisha Gray, Galvani, Volta and Ohm, which had been kindly loaned for the purpose by the owner, Mr. John Horne, of Montreal. The collection included also some copies of an electrical journal called "The Canadian Electrical News," of which five numbers only were published by Mr. Horne in the "sixties," but which, as he states, proved to be ahead of the times. Mr. Horne is an old and practical telegrapher, and ex-Manager of the Western Union Telegraph Co.'s New York Stock Exchange, which at one time did the largest business of any branch outside of the main office. Mr. Horne many years ago commenced the collection of original matter relating to the history and invention of the electro-magnetic telegraph.

At 12:30 p.m. the meeting adjourned till 2 p.m.

AFTERNOON SESSION.

At 2.30 p.m. the President resumed the chair and called the meeting to order.

The first order of business was the reading of a paper on "A Method of Distribution with Equalization of Potential Difference," by Mr. D. H. Keeley, of Ottawa. (See page 140).

Mr. Campbell, in discussing the paper said: Fig. No. 8 illustrates the same idea as No. 6 as adapted to what is known as the three wire system. Are they both of the same size?

Mr. Keeley: They are all of the same size. The three wire system is the adoption of two dynamos. If you were using the three wire system and you increased the voltage to 200 volts, each machine giving 200 volts—

Mr. Campbell: Do you say 200 volt lamps?

Mr. Keeley: No, 100. It does not make a particle of difference.

Mr. Campbell: Whether this figure 8 is a two wire system or three wire system?

Mr. Keeley: It does not make any difference as far as voltage is concerned.

Mr. Campbell, after some discussion on the two and three wire systems, claimed that figure 8 was an impracticable idea altogether, as it would take four times as much copper. In theory and practice it was all wrong, and not equal to No. 7.

Mr. Keeley claimed figure 8 was what he represented it to be. He had made experiments carefully and if it was followed out carefully it could not fail to act.

Mr. Campbell: Take figure 6, it would take more copper and will not give as good distribution as the ordinary parallel system.

Mr. Keeley: It would necessarily have to be a better system. The idea is this, if we were going to supply a block in our immediate vicinity I should run my leads out of this side of the house and bring them in on the other side.

Mr. Campbell: If you could install the plant and build the town around it that would be all right, I suppose. I am in the dark to see how figure 6 is a better distribution.

Mr. Keeley: Well, for instance, you have your station, and the places you are going to supply the current to are about a quarter of a mile away. Your view seems to be that you would be running out four wires and would be using more copper than the ordinary mains. What I say is that you have exactly the same amount of copper you have with your ordinary two wire system. The highest difference of potential you can get at any point will be that from the first end of the circuit. As I have pointed out there in figure 2 you get the difference of potential, absolutely. In figure 2 you get the same potential difference between points 2 and 4 as you will get in figure 1 between the points 3 and 4. I have stated here that this difference of potential must necessarily involve that the current that is received in any one lamp is equal to that you can get at the furthest end of the circuit. Take figure 6 and supposing this is a direct current circuit we are considering. The sources of current D1 in figure 6 are direct current generators for that matter. We will take one lamp placed across between 3 and 4. It is taking one ampere. Supposing we are going away around to F at the further end of the circuit, and we put on 100 lights, we will then have 101 amperes of current running through the circuit. It stands to reason that the electromotive force between those points is the same there with lamp F1 whether we turn on that gang of 100 or turn it off.

Mr. Campbell: The current to run this 100 lamps has to run a greater distance than with a parallel system.

Mr. Keeley: No.

Mr. Campbell: 100 lamps at F. and one at the other place, they are using 49 amperes at F. How does the current run from the dynamo to there and back again?

Mr. Keeley: 50 amperes will run from B, and 50 from D1.

Mr. Breithaupt: I think we ought to have a blackboard at these meetings; where we could then discuss these matters thoroughly and all could see and understand.

Mr. Langton: If the lamp in figure 1 was a certain distance from the central station, say one mile, figure 5 would be the same lamp fed by two central stations two miles apart.

Mr. Keeley: One mile on each side.

Mr. Langton: Figure 6 would be that system folded together so as to consolidate the central station. It shows four wires to the lamp, distant one mile from the station. If these wires are of the same size as they are in figure 1, the loss would be one half and take twice as much copper. I cannot see any difference between this and a straight two wire system.

Mr. Keeley: If you are sending four amperes along the line with a pressure of 100 volts, you have a certain drop in the mains. Supposing you cannot connect it up in accordance with figure 6 you are sending two along on one side and two on the other, and you have a certain drop along the mains. In each case the drop would be one half. In figure 1, instead of having four per cent. drop you will have an eight per cent. drop, whereas in the other you will have only four per cent., and take the same amount of copper.

Mr. Langton: Figure 5 is simply a double system of figure 1, and figure 6 is figure 5 folded together. They have the same lamps, you have to send out the same current and you use twice the length of wire of the same diameter, with consequently half the loss, or you use twice the length of wire of half the diameter with the same loss.

Mr. Keeley: I claim we have a marked saving in the wire. At the same time I admit that the total amount of copper used in the four wires would be equal to the total amount of copper in the two wires. Now, the question comes in, where is the saving? It is here. The statistics of the different general central stations as I have been given to understand is, that out of a total number of 1,000 lamps for which wires have been put in, there is only a demand at any one time for 450. You can put it at 55 or 60 per cent. It stands to reason, at that rate, that the greatest demand at any time is only 60 per cent. on the station for the total quantity of copper that has been put out; there is forty per cent. lying idle. If you have a system by which you can start and give an equal potential throughout the entire town instead of having to run a multitude of circuits for long distances, you can effect an enormous saving in running the wire from the station over your mains for a maximum of sixty per cent. of the number of lamps put in. You save forty per cent. of the copper.

At Mr. Keeley's request the following note, written subsequent to the Convention, is printed as a part of the discussion on his paper:—

Note.—I have to thank Mr. Campbell for bringing out a point that should have been duly considered in my paper. The whole of what obtains in the operation of the circuit in Fig. 7 has not been clearly set forth. The three wire system as represented in that figure has been dealt with as if simply constituting two separate circuits; in the light that if one lamp alone is in circuit between A and C, the current operating it is derived from the source V alone; and if another lamp is put between B and C, it in like fashion gets its current from the source VI. But it should be recognized that in doing this we have doubled the E. M. F., and doubled the lamp resistance, while the other part of the circuit resistance remains unaltered. We know that the E. M. F. absorbed in any part of a circuit is equal to the resistance of that part multiplied by the current, and we can therefore double the E. M. F., and supply double the number of lamps without increasing the current in circuit. This is what is done in Fig. 7, when an equal number of lamps is put on each side of the neutral wire. So if, in the plan as laid out in Fig. 8, the sources of current, V, VI, correspond with those shown in Fig. 7, say 100 volts each, and if the volume of current to be distributed in each case is the same; it is true, as has been suggested, that for a given drop the leads in Fig. 8 would have to be twice as heavy as those in Fig. 7, because the same amount of E. M. F. as is absorbed in each of the separate circuits of Fig. 8 does duty for both circuits of Fig. 7, when there is an equal number of lamps on either side of the neutral wire since the figure then represents what is practically a single round circuit including the sources of current with the two groups of lamps in series, and there is no potential difference between the ends of the neutral wire. When this balance is disturbed, however, by an unequal number of lamps being put on the two sides, a potential difference is set up between the ends of the neutral wire, and the volts thus lost or absorbed in in it have to be supplied from the source that is on the same side as the greater number of lamps. The drop on that side thus becomes greater than on the other, and the regulation of the supply is interfered with. Here then we find a tendency of the sources of current, V, VI, to operate in separate circuits in the same way as they would actually do if the lamps were placed on one side only of the neutral wire, and it might perhaps be better to permanently arrange them so. The system could be permanently balanced if it were practicable to altogether eliminate the neutral wire, or to go to the other extreme and reduce its resistance to nil. Without the neutral wire, however, we could not use the 100 volt lamps singly as at present, and 200 volt lamps are not yet available, so the next best thing is to reduce the interference of the circuits by making the resistance of the neutral wire as low as possible. It is to this end I fancy that in some instances the neutral is given three or four times the cross section of the outside wires, and a great deal further enlargement in the same direction would be perfectly rational, as can be seen, but when it comes to multiplying the total weight to an extent approximating that of the two wire plan of distribution, the best course would be to lay out the wires in the way shown in Fig. 8, so as to secure not only immunity from interference between the circuits, but at the same time an equalization of potential difference throughout the whole. Now the entire argument I have advanced goes to show, I think, that we can obtain what is claimed at the outset of my paper, viz., an equalization of potential difference, with the same total weight of conductor and same drop as obtains in a single two-wire circuit, and the same result in a three wire system with an increase of conductor that has been expressed as 25 per cent., but will have been understood to represent an increase in the proportion of ¾ to 1.—D. H. K.

Moved by Mr. Campbell, seconded by Mr. Breithaupt, that the thanks of the meeting be tendered Mr. Keeley for his very able paper. Carried.

The Chairman called upon Mr. O. Higman to enlighten the members regards the provisions' of the Electric Light Act. Referring to the criticism in the last number of the Canadian Electrical News, page 101, he said: One of the objections is to clause 7, and I explained that the original copy of the draft of the Bill included a number of clauses dealing with underwriters' rules, and acting on a request from the Underwriters' Association, those clauses were subsequently stricken out. Later on, however, when the bill was taken up, that is some few years ago, I found numbers 6 and 7 reinstated for the purpose of giving the consumer the opportunity of being able to test his wires for leakage, giving the consumer the power to call in an inspector to test the wires for leakage. The other principal objections in this article are as to the utility of this inspection. This is a matter of opinion. The Canadian Government has thought fit to inaugurate a system of weights and measures inspection, and that system has been in operation for the past twenty years, as to weights and measures for the sale of ordinary commodities that we can feel and handle. If it is necessary we should inaugurate a system of dealing with these weights and measures, I think it will be readily admitted that with an article impalpable in its character, the reasons are emphasized an hundred fold, as in the case of electricity. Parliament in its wisdom has decided that this is advisable. We will take up the bill and see what we find in it. Starting out we will ask ourselves the question, what constitutes a measure of electricity? What enters into the measure? To my mind there are four questions to be considered: First of all, the insulation of the consumer's wires, the voltage, the limitation or variation of the voltage, the accuracy of the apparatus itself, and the illumination of the lamps, if that illumination is a part of the contract? We simply have power for the testing of lamps for illuminating power, but it strikes me that companies at the present time are not in a position to say that they will give sixteen candle power illumination in a lamp, at least they cannot maintain it, because we know very well after a very short period the lamp deteriorates. Now, taking the first of these propositions, that is, the insulation of the wires, as I said before, that is not very clearly dealt with in the Bill, but in the regulations that we propose arranging for carrying out this work we will endeavor to construe the clause to mean that and provide for it. I think that is a very reasonable provision. We had prepared a Bill with four per cent. as the limitation of variation allowed, but Parliament again in its wisdom has decided that is too much. A gentleman, a Senator who was interested in electric lighting, and who no doubt had been thoroughly primed by the local company which he represented, when this clause was reached, moved that eight per cent. be made the allowable variation. That is out of the question altogether; that would give you sixteen volts or more on a 120 volt system and 8 volts on a fifty volt system. Another very learned electrician who occupies a prominent place in the Senate, told the other gentlemen that they had failed to grasp the intention of the Bill, and he moved that it be reduced to three per cent., and he carried his point, so that the Department is clearly not chargeable with this reduction in the percentage. I may say that we had a good deal to contend against in getting this Bill through—215 members and between 80 and 90 Senators. We will have electricians in Parliament as well as out in a very short time. (Laughter.) I am afraid in operating the fifty volt system the three per cent. will cramp them. It only allows them one and one-half per cent. as the stated voltage. That possibly will be a rather narrow limit. A drop of one volt does not materially lessen the light of a fifty volt system, but it will go half a volt further if there is a want of prompt regulation in the machine, so while three per cent. may be somewhat cramped you cannot afford to exceed it much, otherwise the consumer will not be guaranteed to be getting good light. We will take up next the meters (Clause 13.) It is not compulsory, it is at the option of the consumer.

Mr. Campbell : Is it at the option of the consumer whether the meter is on or not ? It is at their option to have one on ?

Mr. Higman : Yes. It is a question whether the meter system after all will not be the more profitable one, and I do not think the companies need concern themselves very much about that. They rent the meters and the consumer will pay the rent of the meter.

Mr. A. Wright : Have we to put in a meter if the consumer says so and get no remuneration for it ?

Mr. Higman : I am not quite sure but what there is a clause providing for that. I think they can charge the rent for the meter. We have constructed the bill along the line of the Gas Companies' Act, and have complied with that as far as we can without encroaching on the electric light. (Reads clause 15.) That clause I hope meets with the approval of the General Electric Company. It was made expressly for them. (Read clause 22, 23 and sub-seetions, and 28.) That will place the going into operation of the Act about the 1st of March. It is not intended to attempt any more than seven or eight places at the start. Those will probably be London, Hamilton, Toronto, Ottawa, Montreal, Quebec, St. John and Halifax. We are in hopes in the interval of six months we can get these into shape and verify meters in these places.

With regard to sub-section A in the last clause. (Reads.) If the companies undertake to provide absolutely a stated candle power, then I presume that is a part of the meter work.

Mr. A. A. Wright : The Government have not yet decided the number of watts for a 2,000 candle-power lamp.

Mr. Higman : No. The Department has not taken any action and probably will not until this Association comes to us and says, "we want a standard for arc lighting." When that day arrives we shall be very glad to take it up. While I should very much like to see some arrangement whereby contracts with municipalities might be facilitated, I am rather doubtful if this arrangement of energy, the number of watts as a standard, is a proper one. That standard eliminates altogether the lamp and the carbons, two very important factors in arc lighting. That is my view, but it is quite possible that in delivering the 450 watts to the lamp the company's contract would end there. They might get a very cheap lamp with a very poor carbon, and get poor light, but they would perform their part of the contract and there it would end. I do not think, therefore, it is a very good standard. There is perhaps one other subject I can touch upon. (Reads from same clause.) It is the intention for several reasons to employ such machinery as the Department has already in operation. The Gas Inspectors for the most part are very intelligent men, and they are well practiced in those tests. The gas test, as you very well know, is a very delicate thing after all. The test for ammonia and other things requires intelligence and skill on the part of the operator, and I am not without hope that these men will be able to learn how to test the electric meters. It is not necessary they should be learned electricians, but I think they can be got into shape to do the work, and thus lessen the burden on the companies and the consumers, because the consumer is the party who will ultimately pay all the expense.

Mr. A. A. Wright read clause 4.

Mr. Higman : I think you have already done so. I think in most companies they have declared the voltage at which they are working.

Mr. Brown : I think this is a very important point for those who are using the alternating current. For instance, we use the fifty volt transformer, and supplying a man from that transformer, the variation in transformer alone is two and a half volts. We have another drop of two per cent. generally on fifty volt circuits leading into the building, which would make a variation of six per cent. If the Government insists on us regulating within three per cent., we cannot do it, and we will simply have to shut our plants down.

Mr. Higman : But you know already that the drop will be so much, so you can make an allowance for it.

Mr. Brown : But you cannot very well state that. Using a large transformer a man might not use very many lights or might use a lot of them. They will vary as high as five and six volts on these large transformers. You cannot give a man within three per cent., no matter how perfect the regulation in the central station may be.

Mr. Thomson : The ordinary transformer to-day will vary from two per cent. to two and a half per cent. between small load and full load. In a transformer alone there is a greater loss than the Government will allow.

Mr. Higman : At the present time you undertake to deliver 50 volts at the consumer's terminal, or 52 volts. I do not care what it is, but you do state it in your contracts

Mr. Thomson : Suppose there were two houses—one man in one street would use five lights, and the next man would use 55 lights off the transformer ; between those two there is a drop in the transformer of two and a half to five volts without counting the wiring at all.

Mr. Higman : You cannot afford to have a very wide variation on the 50 volt system or you are not going to have a very satisfactory lamp.

Mr. Thomson : I believe it is impossible to get a transformer that will give you 90 or 95 per cent. of efficiency with less than that drop in the transformer. If you decrease the efficiency of the transformer you might get the result of that drop, but the object now is to keep the transformer with very high efficiency. As to the wiring, you cannot wire an ordinary building at one per cent.

Mr. Higman : Take the voltage at the terminals, there would be a loss at any rate, I suppose.

Mr. Brown : I think they ought to give us an allowance of six per cent. on any voltage.

Mr. Thomson : I do not think there is a central station in the country to-day that does not vary more than six per cent.—ten to fifteen per cent. very often.

Mr. Higman : If it is found to be unworkable we can see about that. I hope next year when the convention meets again some progress will have been made in that direction.

Mr. John Langton, of Toronto, was then called upon to read a paper on "A Note on Possible Reduction of Station Plant on Small Electric Railways by Multiple Series Control of Motors." (See page 144.)

Mr. Campbell : I can thoroughly agree with Mr. Langton in reducing the station capacity of the dynamos. In Kingston there is a plant supposed to run five or six cars. We follow out Mr. Langton's ideas in that respect. We run the motors in series altogether. On the generator we run eight and ten to twelve cars instead of six, and the generator is not overloaded. With those cars hauling trailers they will not go over 90 amperes generally. There is not only a saving in the generator, but there is a saving on the motor, in reducing the voltage around the commutator and making everything run easy. It can be all traced, I think, to the parallel controllers.

The Chairman : There is a paper by Mr. John Galt, of Toronto, but he is unfortunately confined to the house and unable to be present. He requested his paper to be presented, and hoped any discussion that might be had would be referred to him and he would be happy to reply thereto.

At 4.15 P.M. the meeting adjourned to take a trip to Back River over the Montreal Park and Island Ry., on the invitation of the management of the road. On arriving at Back River the members partook of their annual dinner at Peloquin's Hotel.

President J. J. Wright was chairman of the evening, and the first toast he proposed was "The Queen," which was responded to with cheers and the singing of the National Anthem.

The next toast was "Our Sister Societies," the National Electric Light Association of the United States and the American Society of Electrical Engineers.

Mr. Francisco in responding on behalf of the National Electric Light Association, said : This meeting to-night reminds me very forcibly of the royal reception that the citizens of Montreal tendered the National Association at the time they held their convention at Windsor Hall here. Whether it was the peculiar effect of the Governor-General's presence that night, or the peculiar air from the ride on Mount Royal that affected the members at the time I cannot say, but I think if a vote had been taken that night that the great scheme of annexation would have been carried out. That is, instead of annexing Canada to the United States, they would have annexed the United States to Canada. (Hear, hear.) The reception received here by the National Association at that time has been not only electrically but indelibly impressed on the memory of every member of the Association, and I trust and hope the time is not far distant when this Associatian and the National Association will be one society and one brotherhood, extending from the Atlantic to the Pacific, and from the Gulf Stream to Hudson's Bay. Then we will alternate these conventions on the other side of the line and on this side, until finally it shall be so managed that there shall be no line, it shall be all one thing. This, I trust, is a matter that will be entertained by your Association. It has been discussed heretofore a good deal, and at our next convention, which I presume will be in Cleveland, Ohio, we cordially invite all of the members of this Association to meet us at that time. We cannot give you the peculiar influence that Montreal has upon the members of any Association, but we will tender you what cordiality and greeting can be produced on the other side of the line. (Hear, hear.) Trusting that this meeting which I have had with you, and the pleasure I have experienced in connection with this meeting with your Association, may be renewed and continued at that time.

Mr. T. D. Lockwood, of Boston, in responding on behalf of the American Association of Electrical Engineers, said: Mr. President and Gentlemen: I would for your sakes I were like my friend, Mr. Francisco, a silver-tongued orator, for I would know then what to say. But I unfortunately do not come in that category. This is something new to me, at least—it has not been my experience for a great many years to be at a dinner where "God Save the Queen" was sung, and I want to say here that I like it. (Hear, hear.) I am glad you did not proceed to go on and sing the other verses, which, if I remember right, and I sung it myself some forty years ago, goes on to confound other people's politics. (Laughter.) Which of course ought to be confounded from a British point of view. It is one of the privileges of a person responding to a toast to say as little on the subject of the toast as possible, so I am proceeding on that line. I am very glad indeed to once more listen to those familiar words which have just been sung. I think we have great reason to congratulate ourselves that in this last decade of the nineteenth century we have some half dozen electrical societies in the two countries, the United States and Canada. We have had more perhaps, but I do not think that there has ever been a time when the electrical societies of these countries have been on so satisfactory and useful a basis. I can remember when at the annual meeting of the Institute of Electrical Engineers it was very hard to muster a corporal's guard. We had the Secretary to read the papers, which were few, and the four or five persons who heard them would go out occasionally with a friend, which would consequently leave no person on the floor to listen to and discuss them. (Laughter.) No doubt many of us are members of that Institute and we receive the proceedings regularly, and while sometimes there are papers no doubt admitted which should not be, as is the case in all societies, as a rule the papers are good, good to listen to and better to read. And I would like to add this suggestion, which I think is pertinent, not only to them but to all other societies, and that is, that it is a splendid rule not to check discussion unless it goes to personalities, for it is my experience as well as yours, I think, that the real value of a good paper lies in the discussion it elicits. I think the American Institute of Electrical Engineers, the National Electric Light Association and the Society with which I have now the honor to be associated, are perhaps the three leading societies of the kind, leaving out, of course, that one of all of them, the Institute of Electrical Engineers of London, which I think is slightly in the lead of any of us, and it seems to me that it is the duty of members, if possible, to prepare papers when called upon, and be ready to discuss papers, because even the youngest of us and the most inexperienced no doubt has something which can contribute to the well-being and instruction of the others, because the experience of each one of us is certainly different. Not only are men different, but they look upon things from different points of view, and frequently a suggestion from one who knows comparatively little about the art in which he is engaged may be the suggestion that others have been looking for, and perhaps in vain. You younger men have advantages which we older men have not had. Most of you are graduates of technical institutes or of other educational institutions where you are not only taught the work but the doctrines and theories and reasons which underlie the practice, which we had to find out by rule of thumb and hard experience. I heard with great interest the remarks of my friend, Mr. Francisco, but I must confess I am not able to agree with some of them. I like the idea of having two societies at least. I like the idea of each nation having its own society, if only for the reason that we can attend the conventions of the two societies and have a dinner with each of them. (Laughter and applause.) And such a dinner as this is enough reason for the separate existence of not only two, but two hundred and two. Thanking you for your kind attention. (Applause.)

The President called upon Mr. Marples, of the Montreal Park and Island Railway Co., to say a few words. Mr. Marples said this was a very unexpected pleasure for him, and in the name of his Company he wanted to thank heartily the members present for the honor they had conferred on his Company by accepting their invitation to travel out over their road. Mr. Marples went on to describe how the work was begun on the road and the difficulties they had labored under. He thought these railways would be one means of building up Canadian cities. His Company had met with great successes that were not expected, and they intended going on and extending their line until the whole Island was encircled.

The Chairman proposed a toast to the Canadian Association of Stationary Engineers, which was drunk amid applause. The toast was responded to by Mr. A. M. Wickens, of Toronto, who heartily thanked the President for calling on him to answer on their behalf. He was proud to say the Society of Stationary Engineers had for years been working on the same lines as the the electrical men. He believed the stationary engineers had more depending on their skill than men in any other business, and notwithstanding all the difficulties they had to contend with, he was glad to say they were holding their own in the land.

A toast was drunk to Mr. McFarlane, who responded amid cheers, and expressed the hope that all had enjoyed their visit to Montreal thoroughly. The Convention had been a complete success.

THIRD DAY.

At 10:30 A.M. on the 21st of September the President opened the meeting and took the chair. The first business, he said, was any discussion there might be on Mr. Galt's paper. As it was a very able paper he did not think it should pass without some discussion on the part of the members.

Mr. Breithaupt: This paper of Mr. Galt's is a very interesting production, and a scientific production to a large extent. We have all recognized the difficulty we have encountered with fly wheels. While I have not had the time to look over Mr. Galt's paper very much in detail, in conversation with Mr. Galt some time ago, I recognized the principles he means to apply in this construction of the fly wheel. He applies the tension on the rim of the fly wheel in a straight instead of in a bending position as it is at present in the spokes. To go into a detailed discussion of the paper it would have to be read up very carefully. I think it is a very able production and I have very much pleasure in moving a hearty vote of thanks to Mr. Galt for his paper.

Mr. Sperry: Before that motion is seconded and put through, I would like to say one word. I read the paper coming up on the train last night and I want to agree with the previous speaker that it is a very ably prepared paper indeed, and it is a subject that is attracting a great deal of attention at the present time, as we all know. In looking at the cuts, (Fig. 7.) it might be thought that in the spokes put in there are some of them tongued, but I do not understand that is the case. It seems each spoke A and A^1 as it goes down from the rim presses upon the hub in a spiral way, passes around on the outside and goes back to the rim. It makes it a very ingenious arrangement, because each spoke not only forms a tangential tension there but forms a lateral brace. This is the first time Table 1 has been published, I think, and it is certainly a very valuable addition to the designer's tables. At a glance it will give you what you want. I am glad this paper has been produced, and I have taken much pleasure in reading it myself.

Mr. A. M. Wickens: There are so many flywheel accidents that the paper to my mind on that ground alone, is most valuable. As the use of engines in this line has increased the manufacturers have begun to make a fly-wheel pulley with a very wide face to get the driving surface for belting, &c., they required, possibly sacrificing the strength of the rim a bit. The article very plainly shows what effect that trouble has. Some years ago we hardly ever heard of a flywheel accident; we did not have the rim we have to-day. At the present time the whole tendency is to get plenty of energy stored in the rim of a wheel, but from the fact that we are spreading our wheel rims out so far we have an inherent weakness there that should be overcome some way. The paper is very valuable on the lines suggested. The requirement to-day is a flywheel with a speed that is safe. Recent flywheel accidents have nearly all occurred in conjunction with other accidents. The engines were going above their normal speed, and of course in building a wheel the idea is to make one that is practically safe at a suitable speed and will keep the cost down. I think if the ideas in the paper are followed out it is highly valuable. I take much pleasure in seconding the motion of thanks. Carried.

A paper on "Telephone Cables, their Construction and Maintenance," was read by Mr. F. J. Schwartz, of the Bell Telephone Co., Montreal. (See page 123).

Mr. Keeley in discussing the paper said: As I happened to be associated with the telephone a long time I take a keen interest in anything pertaining to it, and I must say the Association will be very glad years hence to have on record this splendid paper that Mr. Schwartz has given. Mr. Schwartz says, "at one time the telephone man had the earth." We all want the earth sometimes, and now the electric railway men have it they ought to be very happy. I remember away back in 1872 when I was in a telegraph office in Kingston, I heard of the Western Union putting in a pneumatic tube in New York. They had occasion to put a wire through it and were staggered how to do it. After two or three vain attempts it occurred to Mr. Garrett Smith, who was considered a genius at the time there, to procure a weasel and a rat. He tied a string to the rat's tail and put the weasel in after it and it went through. But this is not on record. (Laughter). In regard to group 7. (Reads from paper). Fancy finding a burn under a clip. Those clips are run along and you will notice at the same time what a very small section of the cable has been cut out. Fancy all these clips to be running from pole to pole and an electrician being able to sit down and say that the trouble is under a certain clip and going down to that pole and taking the clip off and finding the trouble under it. It is a most extraordinary thing, and sometimes it would be very important in the interests of students to know what methods were adopted. Mr. Stevens, who was a prominent electrician of the Maintenance and Construction Company, of London, England, told me once that in all his vast experience he had found that personal equation as it is called generally was depended upon by all successful electricians in testing for faults. Something seems to suggest to a man the method that he is adopting is false, he tries another method and if he gets a reading he is satisfied is correct, he will go that way. If we could from time to time put on record what we have done and how we have accomplished certain results it might in the end reduce the thing down to some rule of thumb method and get results very rapidly without having to go into a great deal of experiment. I have again to express my gratification to Mr. Schwartz for putting this paper before us.

Mr. T. R. Rosebrugh, of Toronto, read a paper on "Duplex Telephony". (See page 140).

Mr. Lockwood : I would like to ask Mr. Rosebrugh what is the longest length of line that this system has been practically operated on. I understand it is being practically tried between Toronto and Yorkville. Is there a practical line being operated in Canada upon the principles enunciated in the paper.

Mr. Rosebrugh : I understand from Mr. Baylis that it has been successfully applied between Toronto and Hamilton but is not in ordinary use, as they very frequently wish to extend one of the metallic circuits further west and the extension would throw the system out of balance.

Mr. Dunstan : Mr. Baylis will be very happy to state exactly what our experience has been. He can tell you better than I can how it works between Toronto and Yorkville.

Mr. Baylis : We have had three lines in Toronto working on this principle. The first one was set up on a trunk line between our main office and one of the branches. This worked very well. This line has worked ever since we put it in, and we have had little trouble with it. We have had some slight difficulty in ringing over the two original lines. The second line was put in between Toronto and Hamilton. This was not satisfactory because Oakville used one of the lines for their conversations., and when they cut in it rendered the other two circuits useless. Last year we built another line and that gave us two direct wires between Toronto and Hamilton, not used for local conversations. We duplexed these two lines and the derived line is now working very satisfactorily for conversations between subscribers in Toronto and Hamilton. But if for instance, Woodstock and Peterboro' were talking over one of the lines between Toronto and Hamilton it would be impossible to use the duplex, as it would be too noisy. We have a three pair cable to the Island, and three stations working there. We left one pair idle and duplexed the two working lines, putting the third station on the derived line. That worked very satisfactorily. There was not very much business done over the line but what was done went through without any trouble. It seems to be a very practical thing to do with long distance lines that are not used for local work. It seems to be a perfectly practical thing to do within certain limits.

Mr. Keeley : I should fancy if Mr. Rosebrugh would refer to the drawing, that in Fig. 2, if the wire marked $2C^1$ were grounded this system would not work.

Mr. Rosebrugh : It is supposed to be connected either with the corresponding point which connects with Q^1 on the second circuit so as to use each metallic as a single conductor or else to use another separate wire connecting with the other end of the first metallic. It will not work as well unless the transposition were perfectly carried out.

Mr. Keeley : That is to say you contemplate using two pairs, that is as illustrated in Fig. 2 there are two metallic circuits and those two are utilized to form the sides of a third circuit. You would have three working circuits on the four wires. How would you manage if you had two wires? Would you have a metallic circuit into 2 and this extra circuit by wire running back to the other end of the line where the $R2\ C^1$ goes in?

Mr. Rosebrugh : I think it could be done that way, but I am doubtful whether a perfect balance could be obtained.

Mr. Keeley : As I see it there would be a leakage. You can talk with that telephone at T 5 ; your transmitted current would be divided at the point T_1 in R and travel both sides of the metallic circuit and come out at the telephone corresponding with T5.

Mr. Rosebrugh : I think that practically none of the current which was produced by either of the transmitters in the original metallic circuit F1 and F2 would pass over that branch, because the middle point, P1, can easily be proved to be of the same potential as the corresponding point at the other end of the metallic. Thus, if you use current produced by either of the transmitters, being of the same potential, there would not be any tendency for any current to go between them.

Mr. Dunstan : In regard to the derived circuit, I would say that if one of the original metallics is thrown out of balance from any cause whatever, not only will the derived circuit be rendered useless, but the original metallic will also be made noisy. You would be obliged to then cut out your duplexing apparatus, and lose the derived circuit until the defective metallic is put in order. If you depend upon the derived circuit for your everyday business, to the same extent as you depend upon actual circuits, you will find it a serious matter to have two lines rendered useless in that way. Suppose you have three circuits, you may find yourself any day with only one circuit actually working. Every trouble is multiplied by two if not three. Of course where the wires are in cables there is not very much danger, but in overhead wires not in cables, and where there is a possibility of lines being thrown out of balance, there is the great objection which I have mentioned to the use of the derived circuits for ordinary everyday business.

Mr. Lockwood : Mr. President, I think I can well conceive a subject like this to be of great interest, but more particularly of interest to some of us, yet to those to whom it is interesting at all it is of vital interest. Of course the one primary thing to be achieved in duplexing telephone lines as well as in duplexing telegraph lines is indicated in the first column of the paper, viz., to place the receiver of one of the sides of the duplexing apparatus in such a position that it will not be operated upon by the transmitter at the same end. The mode of duplexing telephones indicated in this paper is, it seems to me, the most plausible as well as practical way, and probably the way in which success, practical commercial success, will be achieved, if it is at all. I do not think the difficulty in the way of such success is at all over-stated, and for this reason, the changes occurring in the telephonic current must of necessity be equal to the changes in the voice producing the working current, and I think they rise to as high as 28,000 per second sometimes, and of course those difficulties will be accentuated as you increase the length of your line. For that reason I think Mr. Rosebrugh is quite hopeful, and if you will permit me to say so, a little optimistic in duplexing the Chicago and New York line. It is not so that people who are connected with electrical works do not try experiments; although it is often assumed by persons having inventions or writing papers, that those who are practically engaged in any form of electrical application never try experiments with anything. Of course it is not so in this case, as Mr. Rosebrugh knows there are some of us engaged in telephonic work, who occasionally think about such matters as these. And I am very glad indeed that I have the opportunity of rendering a well deserved tribute to Mr. Black, of Hamilton, Canada, who with Mr. Rosebrugh's father, was the projector of the very first mode or method of sending two kinds of communications, one telephonic and the other telegraphic, over the same wires, and that as early as 1878. On the Boston and New York circuits, which are all metallic, we could work each of the two sides as a separate telegraphic circuit, and while we worked the telephonic circuit. Brokers were telegraphing their quotations over the line while we were using the other circuit for subscribers to talk over. The brokers sometimes found out that other people were using the same wire as they and they felt a little aggrieved because they had not a monopoly of the wire, even if it did not make any difference to their work. The man that uses the telephone does not know the two sides are used at all. This was an invention of Prof. Van Risselburg. I may say here that this very arrangement that Mr. Rosebrugh shows in his figure 2, has turned out to be really the best arrangement for telegraphic work on a telephonic circuit. That is, the two metallic circuits may be used for telegraphic work while the telephonic message is interposed between them. Our experiments, however, such as I have had the good fortune to be engaged in, in this line, show that it is very difficult indeed, although we can readily talk over short lines on the methods proposed here, to work successfully a duplex of this nature for an extremely long line, and for the reason that when there are four lines or even three lines engaged in the communication a very small trifle upsets the balance and throws the whole arrangement out. No doubt for lines of small length it will prove quite practically and commercially useful. I will throw out one further remark for which I hope Mr. Rosebrugh will pardon me. Anyone who puts in a paper expects to be criticized. I should not mention this, but he speaks of resistance as being "Ohmic" resistance. I am sure he will agree with me that there is but one kind of resistance, and that, therefore, speaking in cold blood and critically, we should not call it any kind of resistance, but simple "resistance."

Mr. Rosebrugh : I was merely using the ordinary language of the electrical journals of the present day.

Mr. Lockwood : Extra-ordinary language, you mean. (Laughter.)

Mr. Breithaupt : I move a vote of thanks to Mr. Rosebrugh and to Mr. Schwartz for their highly instructive papers. Seconded by Mr. Keeley. Carried.

Mr. Medbury extended to the Association an invitation to hold the next Convention in Ottawa.

Mr. Higman on behalf of the Department of Inland Revenue extended a hearty invitation to the Association to go to Ottawa next year, and guaranteed a first class bill of entertainment would be provided.

Mr. Taylor on behalf of Peterboro', extended an invitation to that town, and pointed out its many advantages ; among others members would have the opportunity of inspecting the Canadian General Electric Co.'s works in operation there.

Mr. Medbury stated that if the Convention were held at about the same date next year, cheap rates could be got on all the railways, which would be an inducement.

Mr. Higman said that as an extra inducement, he thought a room could be got in the House of Commons where the Convention could be held.

Mr. Medbury on behalf of Messrs. Ahearn & Soper extended an invitation to all members wishing to go to Ottawa to-morrow.

Mr. Lockwood : Mr. President, I wish to express to you and to your Association my highest sense of appreciation of the kindness and courtesy which this Association collectively and individually has displayed towards me in inviting me to take part in your deliberations and especially in electing me an honorary member. I do not ascribe all of this courtesy to my individual merits but to the fact that I am still a prominent member of the institution on whose behalf I responded last evening. I have been profoundly affected and highly delighted with the many courtesies and kindly words and actions I have received. I desire especially also to extend many thanks, and my sense of gratitude for the many kindnesses I have received in conjunction with the members present, from the gentlemen who represent the Montreal end of this Association, Messrs. McFarlane and Carroll, and to state that my thanks certainly are due to them for the many pointers and kind words and good things I have received at their hands. (Applause.)

Mr. Dunstan : We have all been more than delighted to have Mr. Lockwood with us. We consider ourselves fortunate that he happened to be here at this particular juncture. We are glad he is our first honorary member. He has contributed greatly to the interest and pleasure of the meetings. His remarks on the papers have been interesting to everybody. I think I express the united sentiment of the Association when I say we hope he may be in Canada next year, and that we may have the pleasure of meeting him at Ottawa.

Moved by Mr. A. B. Smith, seconded by Mr. Yule, that an allowance of $25 be made from the funds of the Association to meet the expenses incurred by our Secretary-Treasurer while in attendance at this meeting. Carried.

Mr. Medbury read a telegram from Messrs. Ahearn & Soper, of Ottawa, extending a cordial invitation to the Association to hold its next meeting in Ottawa.

A vote on the next place of meeting of the Association resulted in favor of Ottawa.

Moved by Mr. Dunstan, seconded by Mr. A. B. Smith, that the next Convention be held in Ottawa, and it be left to the Executive Committee to decide the exact date, it being understood the meeting shall be, if possible, in the early part of September. Carried.

ELECTION OF OFFICERS.

Mr. Black nominated Mr. K. J. Dunstan, of Toronto, for President.

Mr. L. B. McFarlane was nominated, but declined the honor.

Mr. Taylor nominated Mr. John Yule, of Guelph, for President.

The Chairman appointed Messrs. John Langton and A. M. Wickens as scrutineers.

The vote resulted in the election of Mr. K. J. Dunstan. The Chairman thereupon declared Mr. Dunstan elected President for the ensuing year.

Mr. Dunstan said he recognized it was a position of honor and responsibility to which he had been elected, and he would do all he could to forward the interests of the Association.

For 1st Vice President, Mr. Higman nominated Mr. A. B. Smith, of Toronto.

Mr. Paige nominated Mr. John Carroll, of Montreal.

Prof. Rosebrugh nominated Mr. J. W. Taylor, of Peterboro', but he declined the honor.

Mr. John Yule nominated Mr. C. Berkeley Powell, of Ottawa, for 2nd Vice-President.

The vote resulted in the election of Mr. Smith for 1st Vice-President.

As there was only one nomination for 2nd Vice-President, Mr. C. Berkeley Powell, the Chairman declared him elected by acclamation.

Mr. Breithaupt nominated Mr. C. H. Mortimer for Secretary-Treasurer.

As this was the only nomination the President declared Mr. Mortimer unanimously elected.

The 5 members of the Executive who were re-elected for the ensuing year were :

Messrs. George Black, E. C. Breithaupt, L. B. McFarlane, T. R. Rosebrugh, John Yule.

The nominations for the five new members of the Executive were as follows :

Mr. Medbury nominated Mr. John Carroll, Mr. Paige and Mr. D. Starr.

Mr. John Yule nominated Mr. J. J. Wright, of Toronto.
Mr. McFarlane nominated Mr. O. Higman, of Ottawa.
Mr. D. Starr nominated Mr. J. A. Kammerer, of Toronto.
Mr. Paige nominated Mr. J. W. Taylor, of Peterboro'.
Mr. Dickinson nominated Mr. A. M. Wickens, of Toronto.
Mr. Taylor nominated Mr. F. Thomson.

The result of the balloting was the election of the following members :

Messrs. O. Higman, of Ottawa ; J. W. Taylor, of Peterboro' ; D. Starr, of Montreal ; J. J. Wright, of Toronto. J. A. Kammerer, of Toronto, and John Carroll, Montreal, having each an equal number of votes, Mr. Carroll retired in favor of Mr. Kammerer.

The Chairman then called upon Mr. Elmer A. Sperry to read a paper on "Electric Brakes." (See page 133.) Mr. Sperry produced a large number of photographs, which fully illustrated the working of the brake, and which Mr. Sperry used in illustrating his paper. He also brought into use for purposes of illustration a specimen brake.

Mr. John Langton moved, seconded by Mr. Medbury, that a vote of thanks be tendered Mr. Sperry for his able exposition of the Electric Brake. Carried.

Mr. Dunstan moved a vote of thanks to the Press of Montreal, the Montreal Park and Island Ry. Co., the Eugene Phillips Electrical Works, the Montreal Street Railway Co., the Bell Telephone Co., Messrs. Ahearn & Soper, of Ottawa, and all others who had extended courtesies to the Association. Seconded by Mr. Higman and carried.

Mr. McFarlane moved a vote of thanks to Mr. John Horne for the use of the valuable papers that he tendered the Association. Seconded by Mr. W. F. McLaren. Carried.

At 2 P.M. the Chairman declared the Convention adjourned to meet in Ottawa next year.

Immediately after adjournment the members of the Association availed themselves of the kind invitation of the Eugene F. Phillips Electrical Works to enjoy a drive to Mount Royal Park, and of the Montreal Street Railway Company, to inspect their new power station. A couple of hours were thus most pleasantly and profitably spent.

THE ST. STEPHEN ELECTRIC RAILWAY.

The St. Stephen Electric Street Railway is completed and is one of the most thoroughly equipped roads in the maritime provinces. It is laid with 56 pound steel rails. The cars are of the very latest and most improved make. The company has four open cars for summer use, and has ordered three "trailers" to be drawn by the regular cars in case of a rush.

The power house is built so as to be easily enlarged as soon as the growth of the road requires it. There are seven miles of track. Starting from the shore line depot the road runs up to Milltown, then in a south-westerly direction to Calais, Me., and back again to the starting point. The company will endeavor to make the round trip in half an hour. The earnings of the road have averaged over $100 a day since it was opened. Every effort will be made to run the cars during the winter. The company has provided itself with improved snow-plows and all the equipment necessary to keep the road open all the year round.

The St. Stephen and Calais people have had great difficulty in getting the road. The first charter was granted some eight years ago. But two years have elapsed since the matter was actually agitated on this side, and a charter granted to Frank Todd, Henry Todd, C. W. Young, G. W. Ganong and Irving R. Todd. Then Calais parties with George A. Curran at their head had their charter renewed and steps were taken to interest foreign capitalists and have the road constructed. A. F. Gerald, of Fairfield, Me., I. C. Libby, of the Waterville Loan and Trust Company, and H. B. Goodenough, of Boston, from representations made, concluded that there was a chance to make a dollar in the border towns and they guaranteed the necessary capital. The St. Stephen charter was made over to the Calais company, for purposes of management, and the latter company was organized with the following officers :—H. B. Goodenough, president ; I. C. Libby, treasurer ; George A. Curran, clerk ; C. A. Richardson, C. D. Hill and W. H. Pike, directors ; A. F. Gerald, general manager. George A. Curran is counsel for the company and acts as local manager.

After a mutually satisfactory arrangement had been made with the border towns a contract was entered into with the Worcester Construction Company, of Worcester, Mass., and the work of track laying in Calais commenced on June 1st. The cars were running in Calais on July 4th and then a break was made in St. Stephen, where the first car made its trial trip on August 22nd, nearly a week's delay occurring in getting a right of way over the upper bridge. As was natural in connection with an enterprise of such magnitude, there were some conflicts of interest, but the company cheerfully complied with every reasonable demand made upon them. Mayor Clarke in St. Stephen, Mayor Ray in Milltown, and Mayor Murchie in Calais, looked carefully after the interests of their respective towns and gave freely of their time to guard the interests of all. The road is completed as far as it can be until the new bridge is built, and the general opinion is that it is thoroughly constructed and well equipped.

TRADE NOTES.

On another page will be seen an advertisement by Mr. Geo. White-Fraser, who has started a general consulting and constructing electrical engineering practice. The want of independent electrical engineers of experience has hitherto forced intending investors in electrical enterprizes to place themselves more or less in the hands of the manufacturing companies or their agents, who are of course interested in keeping up prices and in pushing the sale of special lines or sizes of machinery, which may or may not be best adapted to their requirements. The special functions of a consulting engineer are watching the interests of his clients, securing for them the best machinery at the best prices, checking the contractors, and generally counteracting the efforts of the agents to secure their own interests at the expense of the purchaser. The specifications whereon electric installations are based should be the work of experienced men, instead of being, as they too often are, made to suit particular "systems" of machinery, to the exclusion of others. Mr. Fraser, by long experience in the lighting and railway field, should be well qualified to ensure the interests of his clients, who, we understand, are already numerous.

The electric fan is being used as the central feature in a game of chance. The modus operandi is to paste a number on each blade of the fan, then cause the fan to revolve slowly, and while it is revolving wage which number will be at the bottom when the fan comes to a stop.

THE INJECTOR.*

By Albert E. Edkins.

When we take into consideration the vast number of injectors that are in use for feeding steam boilers, it seems somewhat strange that the principles which govern their action are not more generally understood. Probably there has no other appliance been placed in the hands of the engineer for operation, of the principles of which he has known less, and yet has been able to work so successfully.

In speaking of the principles which govern the action of the injector, I wish it to be distinctly understood that I do not allude to the pages of complex formula and matter, to be found in every scientific work on the subject, and which are too far advanced for men of limited education to understand; but what I allude to as the principles of the injector is the common, everyday principle involved, and which can be readily understood by any engineer who can read, and is endowed with ordinary intelligence.

We can well afford to leave the formulas for the proportioning of the jets of the injector to the scientist and the makers of them; but what we want is to know sufficient of the principle of the instrument to enable us to keep it operating successfully, and in case of a failure to be able to detect the cause thereof. It is with these things that this paper is calculated to deal.

The injector, we are told, was invented by Gifford over thirty years ago. I have heard it said, or I have read it somewhere, that the original inventor was experimenting with some apparatus on a steam boiler, when he found to his surprise that it was possible to inject water into a boiler by utilizing the steam pressure of the same boiler. This seemingly paradoxical result was very much wondered at, and we can easily imagine that it would be looked upon by many as an utter impossibility.

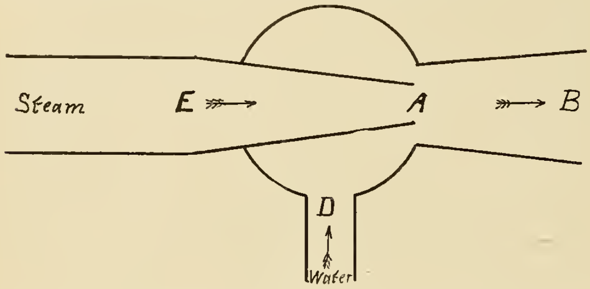

Fig. 1.

Referring to diagram No. 1, to a person having no knowledge of the subject, it does certainly look unlikely that water could be forced into a boiler by the very steam generated within it, and this too (as is often the case) in the bottom of the boiler, where the pressure is greatest, in consequence of the height of water in the boiler.

Diagram 1 represents a section of the injector, and boiler also, from which the injector takes its steam to operate it in feeding water into the bottom of said boiler. A, represents the dome or steam space from which is carried a steam pipe B, which is connected to a cone C, which is connected to a tank full of water D. The cone C is connected to another pipe or cone E, through which the water is driven into the boiler.

All the valves and cocks are left out in the sketch, as they are not necessary for illustration.

To a person unacquainted with steam engineering, the idea of this arrangement of tubes forcing water into the same boiler from which it is supplied by pressure to operate it, might look absurd or impossible, but to us, as operative engineers, it is quite feasible; in fact we see it in successful operation every day.

We will now find out what would be the velocity of steam issuing from an opening of one square inch. If the pressure in the boiler be five atmospheres, or 75 lbs. per square inch, and the temperature of steam at this pressure be 307°F., the weight of 12 cubic inches of steam will be ·001149 pounds.

As the steam has to flow out against the atmosphere, the effective pressure, to which the flow would be due under above conditions, would be 75 lbs. – 15 lbs. = 60 lbs. per sq. inch. If we take a pipe with 1 sq. inch area, and we need to put in that pipe 60 lbs. of steam (i.e., 60 lbs. weight of steam), how long must the pipe be?

To find the necessary length of pipe we have only to divide the total weight, or 60 lbs., by the weight of 12 cub. in. of steam, under a pressure of 60 lbs. per sq. inch, which is ·001149 lbs.

This will give us $\frac{60}{.001149} = 52{,}218$ feet.

If we now take the formula given by D. H. Clarke for determining the velocity of steam flowing from orifices into the atmosphere, viz.:

$$V = 3{\cdot}59\sqrt{h}.$$

Where V = velocity in feet per second.
h = The height or length of a column of steam at the given pressure and of uniform density,

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Then we have 52.219 (228.4=feet
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Then    228.4
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      819.956 = velocity in feet per second, which
                steam at 60 lbs. will flow into the
                atmosphere at constant density.
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Dr. Kinnear Clark tells us that the lowest initial pressure for which the preceding formula for determining the velocity, can be safely used is 25·37 lbs. per sq. inch. This formula has been borne out, we are told by the experiments of Mr. Brownlee.

There is a point regarding the flow of steam through orifices, which I have only became acquainted with myself, since studying the matter up for this paper, and I thought it well worthy of mention. It is this: The flow of steam of a higher pressure into a space of a lower pressure, such as the atmosphere, increases as the difference of pressure is increased until the outside pressure is reduced to 58 per cent. of the absolute pressure in the boiler.

The flow of steam is neither increased nor diminished by reducing the outside pressure below 58 per cent. of the inside pressure, even though the outside pressure be reduced to a vacuum.

This fact was a most surprising thing when made known to me a short time ago, and I have no doubt but that it will be the same to some of my hearers in this room.

But to return to my subject. We find that steam at 65 lbs. pressure will flow into the atmosphere with a velocity of 819·9 feet per second, but this is the velocity of efflux at constant density, and D. H. Clarke tells us that the *actual* velocity of efflux expanded at 75 lbs. (absolute) is equal to 1,446 feet per second. Therefore the velocity of steam issuing from an orifice of 1 sq. inch in a boiler carrying a pressure of 75 lbs. per sq. inch will be = 1,446 feet per second.

We will now assume that we have an orifice of 1 sq. inch in the bottom of a steam boiler, the pressure inside the boiler being the same as before, and we require to know the velocity with which water will issue from the orifice, under precisely the same conditions as in the case of steam.

Of course there will be a slight increase of pressure in the bottom of the boiler, due to the height of the water line in boiler, but as it is small, we may leave it out of the question.

Using the same method as we did for the steam (with the exception of the weight of 12 cubic inches of steam), we have now to use the weight of 12 cubic inches of water, or ·44 and the formula will now be

$$V = 8\sqrt{h} = 92{\cdot}8 \text{ feet per second.}$$

Where V = The velocity of water in feet per second.
h = 136 feet, or the height of a column of water equal to a pressure of four atmospheres,

```
Then we have—      feet
                    136 (11·6 × 8 = 92·8 feet per second
                    1
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                   144
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We now have it that steam, under a pressure of four atmospheres, will issue from an orifice of 1 square inch area at the rate of 1,446 feet per second, while the water under the same conditions will only issue at the rate of 92·8 feet per second; this means that steam will issue from an orifice with a velocity sixteen times greater than water. Notwithstanding the greater velocity of steam over water, as shown, the latter could not be forced into a boiler against (its own) pressure; because the momentum of the two streams are equal, because they are both due to the same head or pressure.

The momentum is the product of the mass ×, the velocity with which it moves, and is expressed in formula thus:

$$V\frac{W}{g} = \text{momentum.}$$

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* Paper read before the 5th Annual Convention of the C. A. S. E.

Where $\frac{W}{g}$ = the weight W divided by the acceleration of gravity g, which is equal to 32.2 feet per second (= momentum). The acceleration of gravity is the force (expressed in feet per second), which the earth exerts over falling bodies, in excess of the weight of the falling body itself and is = 32·2 feet per second.

A given force imparts velocities to two bodies, inversely proportional to the mass, or their respective heaviness or density.

But by inserting the injector, between the forces, we increase the momentum of the steam, and by condensing it with the water, its velocity is imparted to the water, and the stream of water and steam combined, is as it were, forced into the boiler.

A longitudinal section view of an injector is shown in diagram 4.

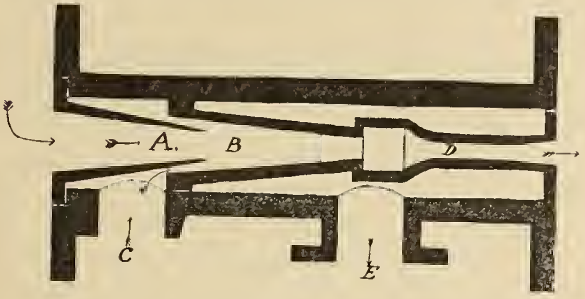

FIG. 4.

A is the steam cone, through which the steam is admitted from the boiler, and let it be distinctly understood that this cone A represents the power of the injector. The steam, in issuing from this cone at a high velocity (as we demonstrated before) is condensed by the water flowing through C, and its velocity is imparted to the water in the cone B. The combined streams of water and steam are then forced into the receiving cone D, where the force of water issuing from the boiler is met and overcome.

The sectional areas of the cones A and D are in proportion to each other as 2·0106 is to 0.7854 (at their respective smallest diameters.)

When the water comes in contact with the steam at the outlet of cone A, it is propelled along by the concentrated steam, and the water (which as you all know is nearly incompressible) is projected into the delivery cone D, and thence into and through the feed check valve and into the boiler, by the impulsive force of the steam, due to its great velocity and elasticity. To sum up the principle of the injector in a short way: It is an instrument which (by the proper proportioning of its jets) takes advantage of the superior velocity with which steam issues from a boiler, as compared with water, and is capable of producing a combined jet of steam and water, flowing through an orifice or jet at a greater velocity that at which an opposing stream of water can flow from the same boiler which supplies the steam to operate it. All injectors (and their names are legion) work on this same principle. The only difference, so far as I know, being that some are water-lifting and some non-lifting, and some are both lifting and forcing combined.

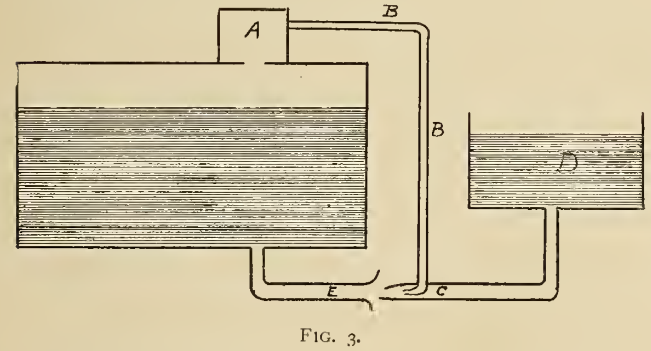

FIG. 3.

In diagram 3 we have a sketch of a lifting jet. Steam enters the pipe at E and issues at the nozzle A, and forces the air out of chamber B to the atmosphere; the air in suction pipe D immediately commences to expand itself into chamber round A, and this action goes on until there is a partial vacuum in D, and the water rises to A by the pressure of the atmosphere acting on its surface, and at A the steam is condensed, and the action takes place which has been before explained. For an injector to lift its feed water, it becomes necessary for the opening B to have considerable more area than A, as, if it were not, it would be impossible to produce a vacuum in D.

Figure 2 represents a non-lifting jet, and it will be observed that the area of the outlet of cone B is somewhat smaller than the steam cone A, and if steam be turned on at C, and issues at A, it will expand and fill the cone B, causing a pressure to back up into suction pipe C. So that with injectors of this type it is necessary for the feed water to be forced into the injector under a head, either by gravitation or from the waterworks mains.

We will now briefly look into a few of the causes of failure of injectors to work.

Injectors often throw off when the temperature of water supplied to them exceeds 130° to 150°; and this is due to the fact, that neath these conditions it requires such a large quantity of water to condense and concentrate the steam issuing from nozzle A, that the velocity imparted to the water is not sufficient to overcome the opposite flow from the boiler, and, consequently, the injector kicks.

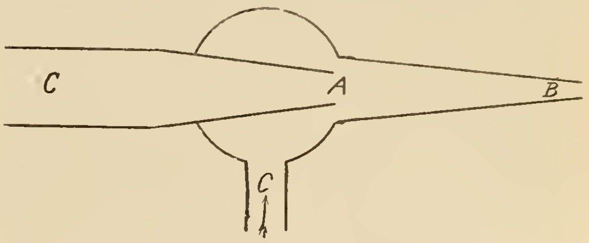

FIG. 2.

Sometimes injectors work along smoothly for hours, days, months, and even years, and then all at once refuse to do their duty.

This may be due to one of several causes.

I have no doubt that some of those present have fed boilers with injectors which took their feed water from a barrel or tank, and when you have started it, and it has worked for a few minutes, and then thrown off, or kicked, as we call it, and you find your water in feed tank is hot; but you say the injector started to work at first, and why not continue to do so? Simply because the injector itself may have been quite cool when it was started and therefore it assisted in condensing the steam from nozzle A, but as it became heated gradually, and the feed water itself was too hot to cool the steam, the injector kicked, and keeps on kicking until you reduce the temperature of feed water. Again, the feed water in the tank may not have been all of the same temperature and as the suction pipe reached down near the bottom, it worked all right until it commenced to take the water of a higher temperature which was in the top of tank when it started, and it kicks again. The injector will always throw off when the volume of steam feeding it is not enough to give it required velocity to overcome the opposing steam or flow from the boiler. Here too, we may be inclined to say, well, but the steam worked the injecter when it was started, and that may have been so; but we must remember that the water that the injector has forced into the boiler has been, comparatively speaking, cold, and this has reduced the velocity of steam from the cone A, and the volume of water entering through feed pipe has remained constant as when the injector was started, and the necessary speed is therefore not imparted to the water with the result that injector throws off.

Then in addition to the above causes of failures there are old-timers, well known to all engineers. viz., leaky suction pipe, no water in tank, end of the supply choked up, foreign matter in the jets of injector, hot section pipe, etc., etc., and I have even known a check valve put on a pipe wrong end to, to prevent an injector from working. I have also known the jets to become coated with a deposit to such an extent as to alter the proportion of area so that they would not work.

There are scores, yes thousands of engineers who use injectors of one of the many kinds; and who, in the event of its failure to work, will take it down, clean it, and remove the cause of trouble, and put it together again and make it work successfully, and yet never once think of trying to enquire into the principles which govern its action, and yet it seems to me that an engineer who is of an enquiring turn of mind (and who refuses to take a thing for granted, simply because there is abundant evidence that it is so, but who enquires into the reason of things, and posts himself as fully as he can on the principles of steam engineering) must eventually find himself in better circumstances than the man to whom it is quite sufficient to know that a thing is so, because he sees it is so, and who is quite satisfied without enquiring the reason why.

It is understood that the Victoria Street Railway Company has made satisfactory financial arrangements and that an issue of first mortgage bonds will be taken by capitalists who have examined into the value of the franchise and assets of the company. The new loan will be used to pay off existing obligations and to place the railway in first-class condition.—Victoria, B. C., Times.

In placing a gauge on boilers, it should be so connected as to take steam from a part which will be as free from vibrations of pressure as possible, that is, away from the outlet of the engine, and a siphon should never be omitted. It is also necessary that the gauge shall not be placed at or near the lower level of a connecting pipe which has a drop of any extent, which will create an excess of pressure on the dial by the weight of water in the column. In a battery of boilers there should be a gauge on each boiler and not one gauge for the whole.

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IN order to place before our readers as early as possible a complete report of the proceedings of the fourth Convention of the Canadian Electrical Association, it has been necessary to considerably enlarge the size of the present number of the ELECTRICAL NEWS. While regretting that we are compelled to greatly condense or omit entirely many matters which we should have like to mention in detail, we are of opinion that considering the variety and importance of the subjects discussed at the Montreal Convention, we could not present to our readers matter of more immediate interest than the report which we publish. It need scarcely be said that the Convention was the most successful one that the Association has ever held. A perusal of the report of the proceedings shows this to be the case. There were a larger number of papers read than at any previous Convention. The subjects treated were all of an interesting character, and in every case were most ably handled. What is of quite as much importance is the fact that the papers were more thoroughly discussed than those at any former Convention. There is still room for improvement, however, in this particular. We expect to witness greater freedom of discussion at future meetings, arising partly out of the better acquaintance of the members with each other. The presence at the Convention of the President of the National Electric Light Association of the United States, and of Mr. Lockwood, advisory electrician of the Bell Telephone Co., added greatly to the interest of the proceedings, and it is hoped that these gentlemen will be seen and heard at future meetings. Another interesting feature was the excellent paper by Mr. Sperry, of Cleveland. It unfortunately happened that Mr. Sperry did not reach Montreal until the close of the second day's proceedings, and the apparatus which he needed to illustrate his paper did not arrive until an hour before the time set for the adjournment of the Convention. This delay was a matter of much regret to the officers and members of the Association. The local Committee, the Montreal members of the Association, and several of the local electric companies, whose names appear in the report, exerted themselves to the utmost to make the visit of the outsiders as enjoyable as possible, and they entirely succeeded. The officers elected for the ensuing year are such as we believe will promote in every way possible the growth and influence of the Association, while the selection of Ottawa as the place of the next Convention is certain to contribute to the same end. The Association is indebted to Mr. J. J. Wright, the retiring president, for the valuable service he rendered on its behalf during the three years he held that important position. His successor, Mr. Dunstan, is known to be a gentleman of good executive ability, who as vice-president always manifested the deepest interest in the welfare of the organization, and under whose direction it bids fair to continue to prosper.

CABLE CONSTRUCTION AND CABLE FAULTS.

By F. J. F. Schwartz.

The number of wires in use when the telephone made its appearance was very small as compared with the number of wires or circuits in use to-day, or even as compared with the number in use after the adoption of the telephone commercially. It follows, therefore, that few wires took any one route or converged to one head or central office, and it was an easy matter to run these lines, each supported by its own insulator, and several inches from any other conductor, while at the central station it was only necessary to provide a suitable roof fixture or cupola where the line wires might terminate. The connection between the lines and the apparatus could easily be made by means of insulated wires supported by cleats. The larger number of circuits made necessary by the increasing number of telephones in use quickly rendered such a method inconvenient, and soon impossible. In the days of comparatively short lines, well separated from one another, with no interfering electric light or power currents, with few or no complaints of cross-talk, the life of a central office manager might have been regarded a comparatively peaceful one. The earth was his.

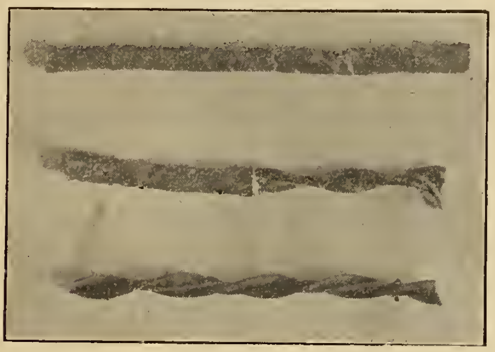
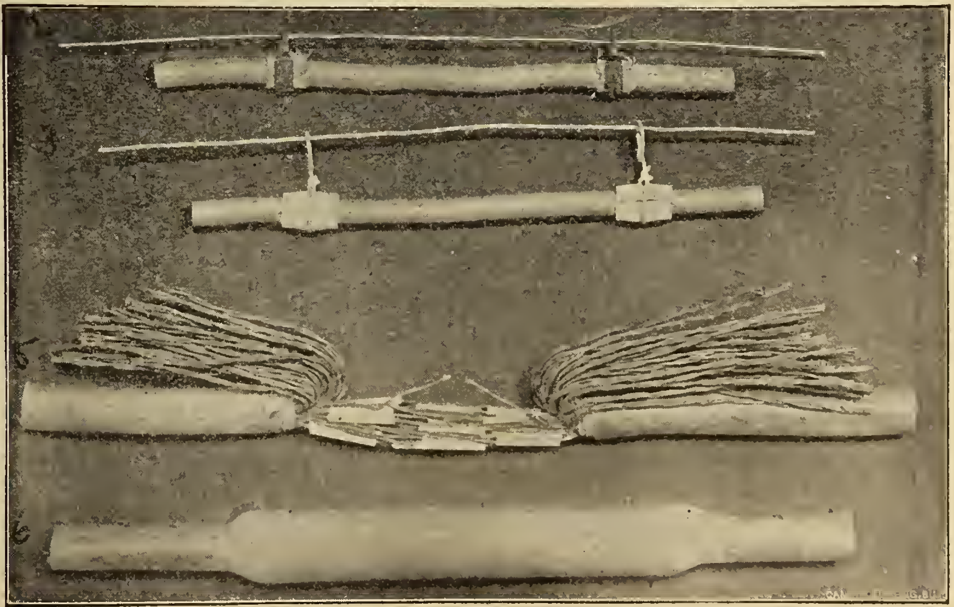


Fig. 1.

The increase in the number of circuits to be accommodated, and the necessary grouping of all the wires in a route into cables, in order to economize space as the circuits neared the office, brought peculiar classes of troubles, or made old ones more noticeable. Briefly mentioned, these annoyances were due, first, to currents induced from foreign wires into the telephone lines, which being cabled with others, would more or less disturb them; second, to the interference between one telephone circuit and another, giving rise to cross-talk; and third, to a muffling of the conversation due to the retardation of the telephonic current. To these must be added all troubles caused by flaws or faults occurring in the cables or joints.

A large number of cables of different kinds are now in use, some especially intended to overcome or prevent the annoyances mentioned. All consist of a specified number of insulated wires bound together, forming a core, which is inclosed in a wrapping or sheath to protect the core from moisture. One of the early forms of cable, which was very light and flexible, was composed of a core of cotton or rubber insulated wires, inclosed in a rubber covering, which was in turn protected by a painted, braided cotton jacket. By far the larger number of cables were of the lead covered type in which the core was drawn into a leaden pipe, and the space between the core and the pipe was then filled with insulating material. In other cases the lead was formed about the core by pressure; the process making the pipe, and covering the core at the same time. In one style of cable, the core was covered by two thin leaden tubes having a layer of tar between them; the outer lead being protected by a wrapping of painted tape. The presence of tar on the outside would indicate a break in the lead, while there was a chance that the tar would fill the break, and prevent the entrance of moisture.



Figs. 2, 3, 5, 6.

It has been mentioned that circuits in cables were found to be more subject to inductive disturbances than separated circuits; and several plans were resorted to with a view of overcoming the difficulties. These consisted generally of winding about each insulated conductor a wrapping of tin, lead or copper foil which was to be connected to earth, and which would act as a shield between each wire and its neighbor by providing a circuit for the induced currents other than by the way of the cable wires. Bare copper wires were also placed among the foil covered conductors to facilitate the connection of the foil to earth as well as to connect the foil of one section of cable to that of another where splices were necessary. Some cables were made with each insulated conductor inside of a leaden tube of its own, the whole forming a core, which in turn was covered with an outer leaden pipe as usual; and still other cables were provided with a single large copper wire placed in the centre of the core.

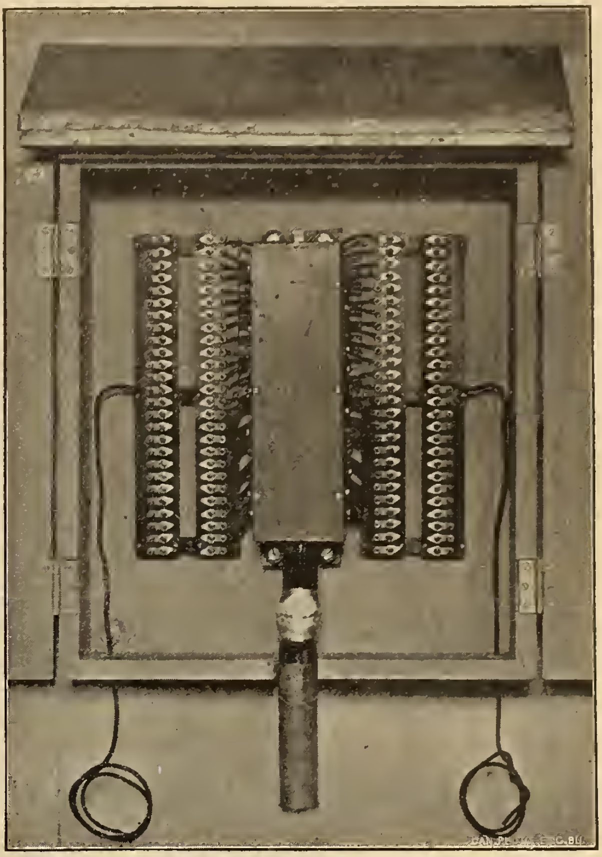
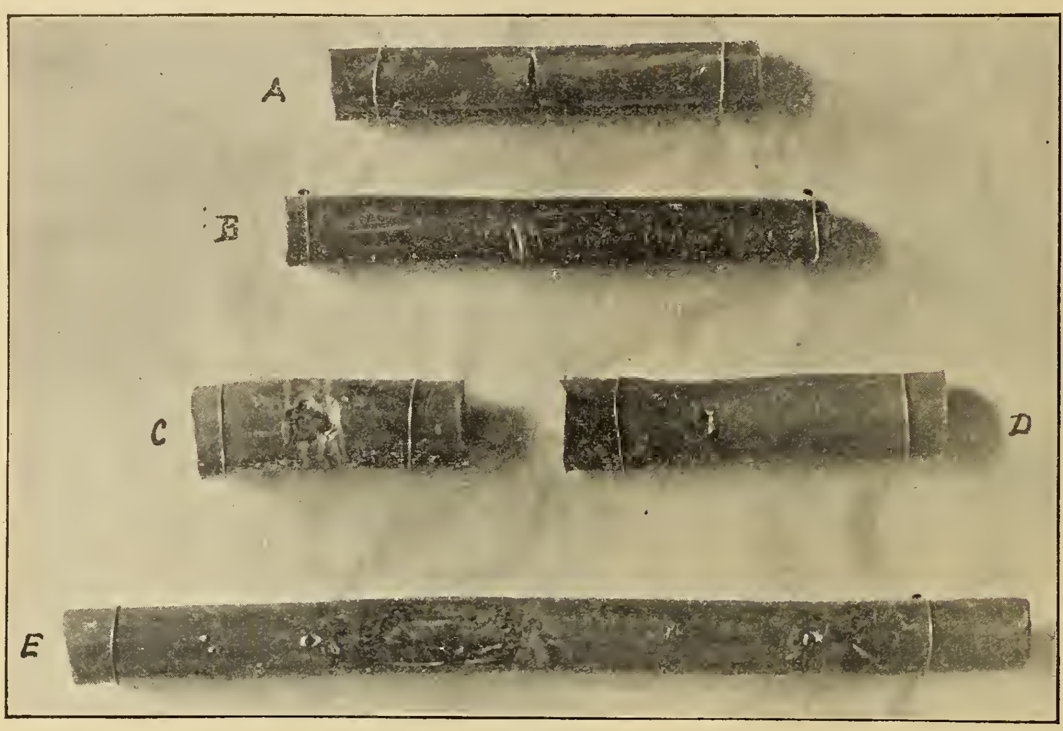


Fig. 4.

With these shields there was less interference between the several wires, but on account of the greater static capacity of cables so constructed, the telephonic currents were impeded and conversations were rendered indistinct. This was most noticeable in the case of long cables. Other cables were made having only a portion of the conductors foil covered; and all of these cables were made for aerial work, as the demand for underground work had not then arisen; in fact, underground work was considered impracticable as much on account of the increased cost as well as on account of the greater amount of retardation that would be experienced; and it was impracticable to operate underground telephone lines of any considerable length when employing the cables of the day, and working with grounded circuits.

The increase of disturbances brought about by the presence of electric light and power circuits seriously affected the telephone service, and it was realized that a return wire would have to be employed for each line in order to quiet them. In the cables hitherto referred to, the conductors were laid up, either straight or in long spirals, while in certain forms the inner conductors were given a twist in one direction, and those in the outer layers were given a twist in the reverse direction. These forms were not adapted for metallic circuit work, as the two sides of a circuit could not occupy the same relation to a disturbing circuit. The cable suitable for metallic circuit work is one in which the two wires used for a pair are twisted together throughout their entire length. The insulation chiefly used for cable wires in the past has been cotton saturated with paraffine or with some other of the many insulating compounds, but for underground work it was found desirable to make cables having as low a capacity as it was possible to obtain. Air having the lowest specific inductive capacity, and dried paper having a very high insulation resistance, cables have been made in which the conductors are loosely wrapped with paper so as to give more or less air space about the conductors. Various methods are employed to still further increase the air space, such as by perforating the paper, or by winding twine in long spirals about the wires, and over which the paper is applied.

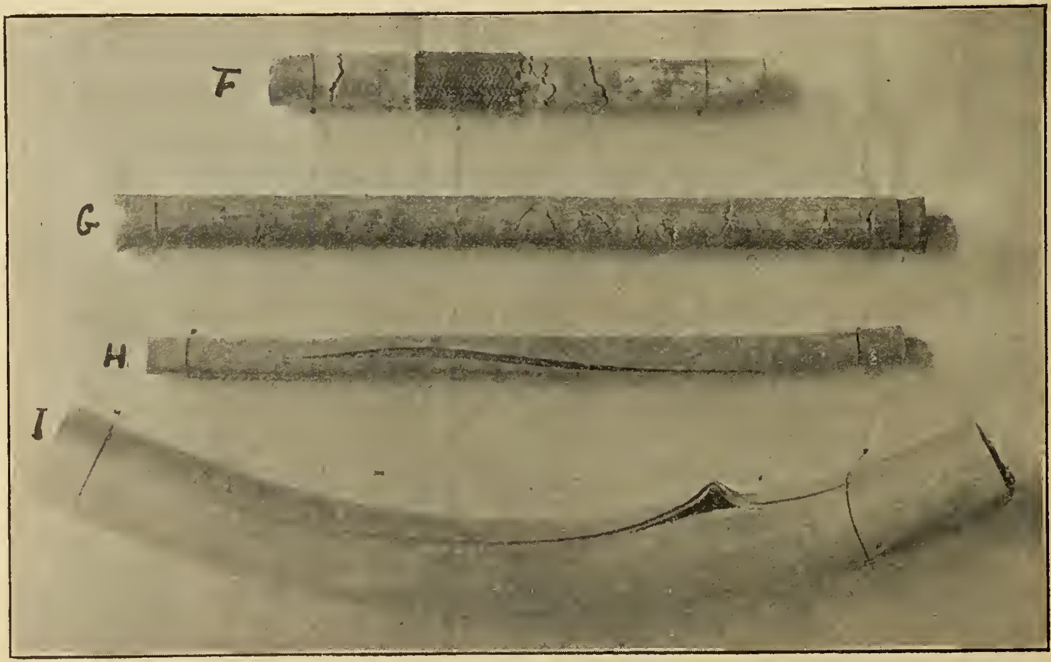
One form of novel construction is shown in figure 1, where two bare wires are inclosed within a paper tube but are separated by a spiral partition, also of paper. The wires lie in the grooves of the paper partition. By this method a large air space is insured, which is favorable to a high insulation as well as to a low static capacity. It is claimed that in cables of this description the capacity per mile sometimes falls as low as fifty-three thousandths (.053) of a microfarad, and that they usually average under seven hundredths (.07) of a microfarad per mile.



Group 7.

According to the specifications for underground cables, the insulation resistance per mile of cable, when connected up, must not fall below five hundred (500) megohms, and the average capacity per mile must not exceed eight hundredths (.08) of a microfarad. Numbers 18 and 19, B. & S. gauge, are the sizes of the wires generally used. The high insulation mentioned is not absolutely essential for good service, but it is desirable as being one of the best guarantees that a cable has been carefully made, handled and spliced.

Paper insulated cables are now in use both for underground and for aerial work. In putting up aerial cables it is necessary to first run a supporting wire, one end of which is brought diagonally from the terminal pole to the ground. By means of this slanting wire the cable is drawn to its position on the poles, where it is suspended by cable clips to the supporting wire. These clips or hangers are sometimes made of malleable iron, and are pressed about the cable to prevent them from slipping, while a piece of canvas placed between the clip and the cable is intended to keep the lead from being marred. Another form of hanger consists of two grooved pieces of wood bound to the cable by wire, one end of which is bent into a sort of hook. It has occasionally happened that the supporting wire has been crossed by other wires falling upon it, with wires carrying a heavy current, and the current has passed to the cable lead at some one of the clips, and the cable has been burned. With the wooden blocks, a foreign wire must make contact directly with the cable lead in order to burn it. Figures 2 and 3 show methods of supporting the aerial cables. At the terminal pole, the end of the cable is brought through a leaden pipe into an iron box, where the wires are secured by means of insulated screws, nuts and washers. The screws pass through insulating bushings to the outside of the iron box, where, between other nuts and washers, are connected the short wires leading from one end of the fusible wires provided for the protection of the cable. Waterproof insulated wires lead from the other ends of the fusible wires to the line wires on the poles. The entrance tube at the bottom of the iron box is wiped to the body of the cable, and when the cover is screwed on the terminals are moisture-proof.



Group 8.

Figure 4 represents one of the forms of cable terminals now in use. It accommodates twenty-six pairs of wires, and, with its fuse wires, is inclosed in a wooden box. The office ends of the cables are similarly sealed, but special forms of arresters are generally secured to the outside of the iron boxes. These arresters connect to ground any circuit carrying a dangerous current, whereupon the fuse in the outside cable-box is melted, and any current is prevented thereafter from entering the cable. Spark-gap arresters are also employed in combination with the above.

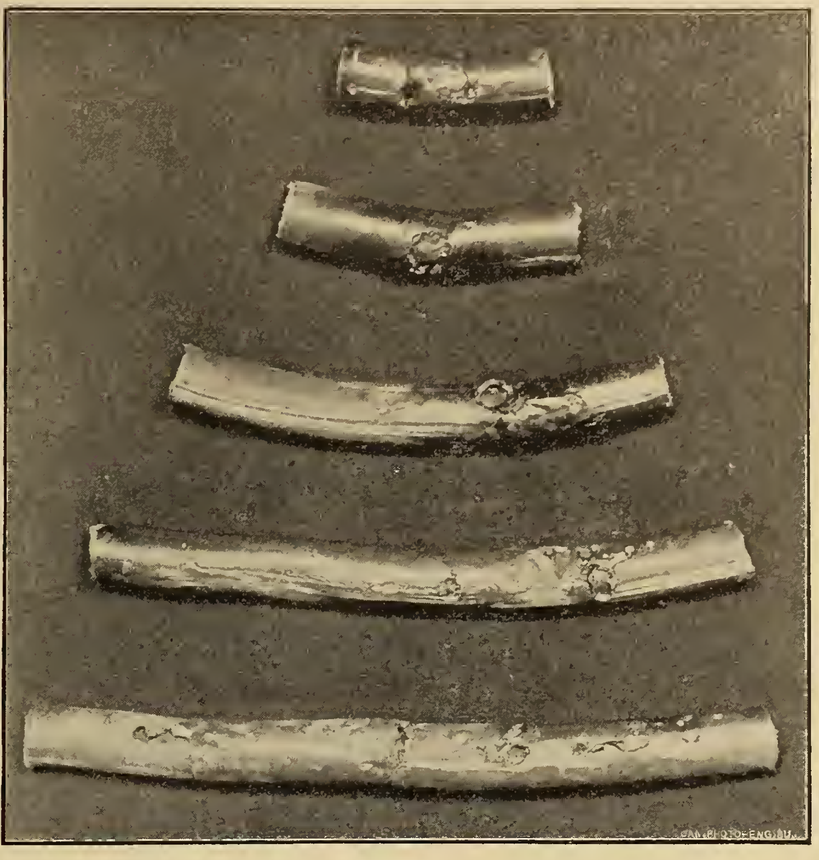
When it becomes necessary to run a cable underground, jointed poles are pushed through one of the ducts from one manhole to another. To the last rod a rope is fastened which, when pulled through the duct, is used in drawing the cable. The lengths of cable handled at a time in underground work are much shorter than those that can be easily handled in overhead work, and consequently there are splices in nearly every manhole. Splices, as made in paper-insulated, underground cables, are shown in figures 5 and 6. Figure 5 shows the splice partially made, and figure 6 the completed splice. The wires are bared for a short distance, and a paper tube is passed over one of the wires. The wires are then spliced so as to form a long twist, after which the paper tube is drawn over the joint. The joints are not soldered. After all of the wires are connected, they are bound together with paper and twine to prevent the paper tubes from slipping, and then boiling paraffine is poured over the splice until all moisture is expelled. This is indicated by the absence of bubbles. A leaden sleeve, previously passed over one of the cable ends, is next drawn over the splice, and the ends of the sleeve are wiped to the cable lead.

We will next consider the faults which cause the most annoyance, and it may be generally stated that some form of injury to the cable lead gives rise to nearly all of them. In the older work the wiped joints were made by plumbers, and as this work was done on the poles or in the middle of a stretch, it sometimes happened that the work in time proved to be faulty. Referring to group 7, fault A was originally started by a slight cut, and it afterward opened out in handling the cable. Fault B was caused by a wire resting against, and sawing into the cable. Faults C and D are samples of small trolley burns, C occurring under one of the iron cable clips. In sample E the holes shown were caused by linemen's spurs. Such faults rarely occur, and this is but the second of the kind that I have seen.

The faults of group 8 differ from those previously shown in that they are due chiefly to flaws and faults in the manufacture of the leaden covering. The cracks shown in F and G are evidences of poor or damaged material, possibly the lead may have been burnt. In the cables from which samples H and I were taken, a seam extends along the entire length. Ordinarily it cannot be detected, but sometimes it will open out as shown, and it is quite likely to do so if the cable becomes twisted while being pulled.

When the trolley system was introduced, it was found that some of the lower hanging cables were dangerously near to the trolley guard and supporting wires where the latter were fastened to their poles, and just beneath the cables. Group 9 represents a number of burns which occurred in a single stretch of cable. Another burn occurred quite recently in an underground cable which has, however, aerial branches used in connection with it. A broken wire crossed one of the aerial branches of the cable with the trolley wire, and a hole was burnt in the lead at the point of contact. The cable wires were not injured at this point, but the current passed into the lead of the underground cable and finally to earth in one of the manholes, where it fused the lead and burned into several pairs of wires. This will have to be guarded against by providing two terminal boxes at each junction with the underground cable. The lead of the two cables will not then be continuous, but the conductors will be connected through by short wires from box to box.

The amount of underground work in Montreal is at present small, and there has been no destruction caused by electrolysis. There is, however, considerable difference of potential between the cables and the earth at different points, and it is probable that trouble will be experienced. Enough has been shown to prove that cables are sufficiently liable to faults and injuries without those due solely to carelessness. With overhead construction more or less of the mentioned faults will still continue to occur, and with underground cables the troubles, though fewer in kind, are no less destructive. To meet these, special means will have to be adopted as occasion requires.



GROUP 9.

THE APPLICATION OF ELECTRICITY FOR MEDICAL AND KINDRED PURPOSES FROM LIGHT AND POWER CIRCUITS.

By W. B. Shaw.

Mr. President and Fellow Members of the Canadian Electrical Association.

When the thunderbolt in the shape of a letter from our worthy Secretary fell upon me demanding a paper, I was at a loss as to what to launch out upon. I have heard so many able papers on various subjects already read before the Association, that in searching around for "pastures green," I thought that the above subject might be of interest to some—if not for its "electrical" instruction, then for its "novelty." I have headed these remarks, "From Light and Power Circuits," but there are no doubt many here who are interested in battery work, so there will be no harm, I presume, in my detailing the battery methods a little before showing how they can be more readily and less expensively worked from the circuits before mentioned.

Let us take first the dentist, who probably uses electricity least of all. Yet let us see what this "least" means. No enterprising dentist nowadays thinks of standing on one leg (while the temperature is about 100 deg. in the shade) working his foot-drill with the other. They run by motor. Some have 2 or 3 cells of accumulators and run a small 4 or 6 volt "Crocker Wheeler," or "C & C" motor. The cartage around, however, of the accumulators to have them re-charged, makes this an expensive method, and of course the 110 volt direct current is much preferable. Unfortunately, in Montreal, there is very little of this to be had, and quite a few dentists decline to handle a 250 volt motor, even though it is of small power and properly insulated. There is another reason also, and that is that they generally use a pedal switch for starting and instantly reversing. The accumulator outfit is easily regulated by switching in one or more cells as required. With the 110 volt outfits a rheostat is put in the field circuit. In both cases the wires from the circuit are first led to the pedal which sets as a pole-changer before the current is let into the armature. Some members may think that this instant reverse would be apt to put a finish on the armature. All I can say to this, gentlemen, is that I know of a ⅙ H.P., Crocker Wheeler, 110 volt motor which has been treated in this way for the last 3 or 4 years and is still going. I fancy, myself, it is because there is no weight to the armature. With 250 volts, however, it is a different matter. The flame which would flash around from the brushes on attempting this would certainly frighten any patient out of a dentist's chair, so in this case we have to use a motor transformer, taking 250 volts on one side and delivering current at 8 volts (used in conjunction with the storage battery motor) or at 110 volts, where the motor is wound for same, the motor transformer to be put on a bracket near where power wires enter. Most of us who have sat in a dentist's chair can tell exactly the moment when the dentist is awaiting the momentum of the fly wheel to carry him over the dead centre point. The drill slows up a little and suddenly makes a rush, but I need not detail this, for it is no doubt a case of "You've all been there before," or at least a good many of you at any rate. But the electric motor keeps the drill running at a constant and steady speed. It is instantly reversed if necessary and under perfect control. It is also a known fact that the faster the drill goes the less pain will be caused. The power required for the S. S. White Standard Upright Pedal Drill is from 1/12 to ⅛ H. P. For the small lathes which dentists use in their workshops for buffing plates, artificial teeth, etc., a ⅙ H. P. motor would be required.

All the above figures refer to an ordinary practising dentist. Where a man has a rush of trade it may pay him to run a small dynamo (say ½ H.P.) with a motor and connect on his small motors from a pair of bus wires run around the room.

Probably some of you have heard of the "pull teeth without pain" idea. Personally I do not take much stock in it, but I must admit that I have seen a patient operated on who affirmed he felt no pain. The idea is this. A German savant declares that if the vibrator of an induction coil is caused to vibrate with such rapidity that the buzzing tone will be the same as the note "A," that the electrical vibrations will be quicker than the impulses of pain vibrations from the nerve centres to the brain. The mode of application is as follows: The patient is given 2 handles from an induction coil driven by a battery; the plunger is then pulled out until he says "Enough"; the battery is then shut off for an instant by means of a floor push; the 2 handles which the patient is still holding being connected together now on to one pole of the battery, the dentist, taking a flexible wire from the other pole to his forceps, immediately on pulling the tooth (or rather just as he begins to pull), sets the coil in action again by means of pressing on the floor push.

Of course the above can easily be worked by means of a straight current with a proper rheostat. Our dentist will also use a small electric light for examining cavities in the mouth. This not only shows up the decayed parts in the teeth, but renders the teeth translucent. Once in a while a dentist can use hot cautery wire for what they call "dentine" work.

It appears from the above that the straight current station has the best of it. This is so as regards the motive power. for the alternating motor is not very successful for such work. The writer has had one of the Meston types specially wound, and it is now running for such work, but certainly it has not given as good results as the straight current motors do, and I have been unable to find any small alternating motor suiting our rapid alternations. Instant reverse of course is lost; but when we come down to illuminating the small lamp and working the cautery I think that any of you will agree that the small transformers now on the market for such work are most convenient, ahead of a rheostat where straight current is used and altogether over and above the storage battery. One thing I have noticed, and it seems grossly absurd, for dentists and medical men generally who use cauterizing tools to have a storage battery giving a rated output of 7 amperes when of the many cauteries I have tested the current taken by the smallest was 12 amperes and by the largest 48 Many and many a storage battery has been ruined by this work. It is simply nonsense for medical men generally to try and save $5.00 at the start only to lose $20.00 later on. The item of power supply may appear small to a power station, but remember, gentlemen, these professional men are about the only ones who can help you out with a day load on your lighting circuit, and when I tell you of one dentist with simply one assistant using over $140.00 worth of current in one year, you can readily see that a few such would be no little help.

So much for our friend the dentist.

Let us now turn our attention to the oculist. He is a difficult man to please in regard to light, as when he examines the eye with the small species of pocket telescope which he has for the purpose, he gets a double reflection, showing the filament on the eye and spoiling his examination. To overcome this, use a frosted lamp. Have the filament "edge on" to the eye of the patient and use a Ries reducing socket, so that the oculist can tone the light down to suit himself. The opthalmascope, or instrument for testing the sight, is easily illuminated by means of 4 8 C. P. lamps clamped all around the wooden board where the face of the patient is set. These lamps are all shaded from the patient's face by means of aluminum shades shaped the same as the half of an incandescent lamp, the light being projected on the black bridge by means of the telescope through which the oculist looks.

The nose and throat specialists simply use cauterizing apparatus, which is easily accomplished on alternating current by the small transformer before referred to; but as the cauteries used, especially in those cases, are excessively large, it is impossible to economically use straight current for the purpose unless in conjunction with a couple of large cells of accumulators. I have seen one cautery which consumed about 68 amperes at about 4 volts to get it to the proper white heat.

I do not intend in the slightest to speak of electric belt and other appliance men, lightning hair brushes, &c. One quaint little note of Sylvanus P. Thomson in his book entitled "Electricity and Magnetism" covers their case very nicely, and with your permission I will repeat it. He writes as follows:—

"It is not out of place to enter an earnest caution against numerous quack doctors, who deceive the unwary with magnetic and galvanic appliances." In many cases these much advertised shams have done incalculable harm. In the very few cases where some fancied good has accrued, the curative agent is probably not "magnetism" but "flannel."

It may not be out of place either to call the attention of our worthy organ, the Canadian Electrical News, to the manner in which the Electrical Review, of London, England, is exposing all such nonsense. It is not long since that the writer of this paper was offered on sale near the post office in Montreal, "bottled electricity for curing headache."

A few words may not be amiss in regard to "Electrolysis," as the removal of superfluous hairs is termed. It is a simple operation and consists of destroying the hair by decomposing the watery tissue at the root of the hair. A simple equipment for this is to use say 10 cells of the large size Samson battery with a 3 pt. switch giving 5 cells, then adding 3 more and 2 more, the strength being regulated according to the resistance encountered at the positive electrode. The usual mode of operation is as follows :—

The patient takes a sponge electrode in one hand, this being connected with the positive pole ; the operator inserts a fine needle, which is in connection with the negative pole, at the root of the hair. The reason the negative pole is used is that if the needle were attached to positive a black spot would be left owing to the metal becoming oxydized. It may seem strange to you, but it is a fact, that there are specialists in this city for this work alone. I believe they also remove wine marks and other facial blemishes by this means, in such cases using a number of needles in one handle. This work of course cannot be done with the alternating current but can be done with the straight current through a suitable resistance or in conjunction with a few small cells of accumulators.

I have said enough about specialists and will only mention one other specialty, although it really has nothing to do with the medical line, before getting down to our doctor or regular practitioner proper, i. e., the photographer. Give him two drop lights in his dark room, one equipped with a spring cord adjuster, an ordinary socket and a 32 C. P. lamp with very light frosting ; the other light to be left conveniently within reach and equipped with an 8 C. P. ruby glass lamp and Ries regulating socket. The red light hanging low is of course most handy and he will turn it on slowly, getting the desired amount of light according to the sensitiveness of the plate he is operating on. When red light is no longer absolutely necessary he can reach up and pull down his white light, by this means having every facility without the danger of lighting a match where collodion and other inflammable chemicals are lying around. If alternating current is not there, a Ries socket of course cannot be used, but a carbon rheostat switch as manufactured by the McCreary Electrical Specialty Co., of New York, can replace it.

Now let us take our regular practitioner and see what he wants.

1st. Current for small examining lamps and for cauteries.
2nd. Current for galvanic work, for removing fibroid tumors, &c.
3rd. Faradic current for rheumatic and paralytic patients.
4th. Mild continuous current for nervous diseases.

For item. No. 1 the usual way at present is to have a couple of cells of accumulators or a bichromate plunge battery.

For the 2nd 48 or 50 cells of Leclanche battery, a milliampere meter and a double collector switch as made by Gaiffe of Paris.

The 3rd current is supplied from many of the Faradic portable batteries with induction coil for physicians, or sometimes they use the coil alone connecting it to 2 or 3 cells of Leclanche battery from their Gaiffe outfit, i. e., when they have such an outfit on the premises. I may say that physicians have dropped the old magneto electric crank machines almost altogether.

The 4th current uses an outfit similar to that described for No. 2, except that they have an adjustable rheostat as well as the Gaiffe double collector switch, also a button for interrupting the current and a double arm switch to act as a pole-changer.

You can see how readily all this business can be done with straight current at say 110 volts, a proper rheostat and one or two cells of accumulator. The accumulators would attend to the small examining lamps and the cautery. The straight current and rheostat would do away with the cumbrous cabinet containing 50 Leclanche cells, also with the nuisance of continually replenishing the cells with water, testing them for breaks in the wire, putting in new zincs, recharging, &c. This matter of broken wires is an important one, as the Gaiffe collecting switch has a wire running from every couple of batteries, so that the current is increased by 2 cells at a time, there being 2 switchboards with the contacts cross-connected. It is evident that the difference of the two switch levers is what will be given to the patient ; for instance, if we place the left hand switch lever on 10 and the right hand switch lever on 20, the patient will be getting simply 10 cells. This arrangement is convenient as a doctor invariably uses up his first sixteen cells more than any of the others. Of course the Gaifte board requires considerable wiring, in fact, a 25 wire cable from the batteries ; but, as I have had considerable experience in fitting in these outfits, I find that in the long run this board gives much more satisfaction and a closer range of current than the various forms of carbon and water rheostats sold by some American firms to take the place of the Gaiffe board. The contact on the switch arms is so arranged that it slides on to one contact before breaking with the preceding one, and so on. A broken wire would cause the patient to receive a violent shock, which in internal examinations might prove fatal. A worse objection is, however, open to the straight current brought in from outdoors, viz :—contact with a higher tension wire.

The treatment of Faradic current I need not dwell upon here. It is simply use your induction coil. It is employed for cases of rheumatism, paralysis and drowning. In the latter case the contraction of the diaphragm and chest muscles would serve to start respiration. Some medical men, notably those from Paris, go in for what is termed "Franklinism," which is to charge up a patient from a frictional machine, and after charging him full draw the current off from various portions of the body by various devices, but this is not much in use. A small ⅛ H. P. motor either direct or alternating can be used to drive the machine.

I had almost forgotten one item, i. e., heating apparatus, which is handy for a medical man ; a hot water heater for his bandages, etc.

Before closing let me describe how I would propose to put in an outfit for a physician giving only the currents which we have in Montreal, viz :—52 volt alternating, and 250 volt direct. I would proceed as follows :—

I would have the 250 volt current run into the basement of the doctor's house and connected up to motor generator of the 1 H. P. type, which gives 500 watts at the secondary end. The primary would take 250 volts ; the secondary would give it off at 52. This motor generator would be operated by means of switch and rheostat placed upstairs in the doctor's operating room above the basement. The 52 volt secondary direct current wires would go to the lower terminals of a double pole, double throw switch. The house circuit for lights, &c., would come to the connecting knives or central contacts of the same switch, and I would have the 52 volt alternating current run in and connected to the upper contacts of the same switch.

I purpose to leave the motor generator running during the daytime. The main switch would be down. There would be sufficient current for house lights, charging accumulators, running cauteries, motors, Faradic coils, galvanic current, &c., from it, and as a reserve he can throw up on to the alternating current, which can still continue to light his house lights, work his cautery this time by means of small transformer, &c.

I think, gentlemen, that I have proceeded about far enough with these rambling remarks, but it may show that there is a bigger field for ingenuity than was imagined by catering for the fitting of a professional man's electrical plant. I should have preferred had time permitted to condense this rough draft of mine in some points, and explain more fully the electrical data, but being exceedingly busy for some weeks back I must plead this as an excuse for not doing so. I shall be happy to answer questions in so far as I am able, and thanking you, gentlemen, for your kind attention, I will now close this paper.

ALTERNATING CURRENT MOTORS.

By L. M. Pinolet.

THE alternating current system possesses many advantages for the transmission and distribution of electrical energy, but until recently has labored under the disadvantage that it could only be employed for lighting, except in a few special cases, as there were no alternating current motors suitable for general use. This drawback has now been overcome, and self-starting alternating current motors of simple construction and high efficiency can be had. As the alternating current system is so extensively used and is so suitable for the long distance transmission of power, these motors have attracted much attention, and it is my intention to explain briefly in this paper the principles of construction and operation of some of the most important types of the motors.

It has been known for a long time that an alternating current dynamo of the ordinary single phase type, would run efficiently as a synchronous motor, if its armature were supplied with an alternating current and its fields were magnetized by a continuous current. To illustrate the operation of this type of motor, let us take a four pole motor whose armature windings are connected with a source of alternating current, and are arranged to produce four poles to correspond with the four poles of the field, two of which are north poles and two south poles. The strength of the magnetic field necessarily varies uniformly in all the armature poles. If at a particular instant, one of the poles be a north pole, the two adjacent ones at right angles to it are south poles. At the next alternation of the exciting current, the first named pole will be a south pole and the two at right angles to it will be north poles, and so on the poles will change for successive alternations of the current. It is thus apparent that the action of the alternating poles of the armature upon the poles of the other element of the motor, is at one alternation of the current in a certain direction and at the next alternation is in the opposite direction. The attraction at one alternation is thus neutralized by a repulsion at the succeeding alternation, and consequently the motor will not move. But, if the movable element be rotated in either direction at a synchronous speed with the shifting of the magnetic poles of the armature, the armature poles can be brought into such a position with respect to the field poles that the attractions and repulsions between them are always in the direction in which the motor is running. The motor will then continue to run at a synchronous speed and will stand a considerable overload without being thrown out of step, or synchronism. A synchronous motor is usually brought up to speed by a small non-synchronous motor of one of the types described below. When the large synchronous motor is running at the proper speed, it is connected with the line by a switch and the load is thrown on by a friction clutch.

The difficulty of starting these synchronous motors has rendered them unsuitable for general use, and a number of electricians have worked at the problem of making a self-starting motor for single-phase alternating currents.

One of the methods adopted is to provide one of the elements of the motor with two energizing circuits which produce separate sets of poles in the element. The alternating currents in the energizing circuits are caused to differ in phase and thus set up a rotary magnetic field in the element, as in a two-phase motor. The rotary field induces currents in closed-circuit windings on the other element of the motor, which currents cause the motor to run by their action on the rotary field. The difference of phase between the currents in the two energizing circuits can be obtained in one of the following ways.

Both circuits are connected to the same source of alternating current, but the circuits have different coefficients of self-induction, so that the current in one circuit lags behind that in the other. The difference in the self-induction of the two circuits may be obtained by inserting a condenser in one circuit and a self-induction in the other.

One only of the circuits is connected with the source of alternating current. The other circuit is closed on itself and is within the inductive influence of the first circuit. The alternating currents in the first circuit induce currents in the closed circuit, which differ in phase from the inducing currents.

In another type of single current motors, the rotary element is provided with normally open circuit coils, whose terminals are connected to a commutator, and the field of the stationary element is excited by an alternating current. By means of brushes, the circuits of the coils are closed when they are in such a position that the magnetic field of the currents induced in the coils by the exciting magnetic field, is assymmetrical with respect to the exciting field. The field of the induced currents is repelled by the exciting field, and thus the movable element of the motor is caused to rotate.

If the movable element of a motor of the above described type be provided with a number of closed circuits, the field of the currents induced in the closed circuits will be symmetrical with the exciting field when the motor is at rest. The repulsions will then be equally strong in both directions, so that the motor will not rotate. But, if the movable element be rotated in either direction, the fields become assymetrical with respect to each other, and the repulsions are greatest in the direction in which the movable element is rotating, so that it will keep on rotating when started, with a tendency to synchronism. These motors can be started by an extra energizing winding, used only at starting, in which the current is caused to differ in phase from that in the regular energizing circuit by one of the above-described methods. Or the motors can be started without a starting winding, if the circuits of the coils of the rotary element are open and are connected to a commutator. The motor is started, in the way already described, by closing by suitable brushes the circuits of the coils when they are in such a position that their magnetic field is assymmetrical with respect to the exciting field, and, when the motor has acquired its proper speed, the circuits of all the coils are closed. Prof. Elihu Thomson, who has done much to develop motors of this type, says in a recent article that they have attained a fair degree of perfection, though the writer of this paper is not aware that any reliable tests of their efficiency have been published.

Having examined the principal types of single current motors, we will consider the polyphase motors which are self-starting and of an extremely simple construction.

A polyphase motor consists essentially of a rotary and a fixed element, each provided with suitable windings. The windings of one of the elements are supplied with polyphase currents, which consist of two or more separate alternating currents having the same frequencies, but whose phases differ from each other. These currents set up a magnetic field in the element, which field is rotated, or progressively shifted, around the element, by the combined action of the different currents. The rotating field attracts the field produced by currents in the windings of the other element and thus causes the movable element of the motor to rotate. This principle, upon which a polyphase motor operates, is analagous to that of a continuous current motor, for the commutator of a continuous current motor produces a rotation, or progressive shifting, of the magnetic field of its armature. The attraction between the rotary field of the armature and the stationary field of the field magnets, causes the armature to rotate.

In this paper, in order to avoid the confusion at present existing as to which element of a polyphase motor is the armature and which is the field, the element in which the rotary magnetic field is produced is called the armature, and the other element is called the field.

To illustrate the working of polyphase motors, we will take as an example a two-phase motor with a stationary armature provided with two sets of windings. The two windings are supplied with separate alternating currents and produce two pairs of poles at right angles to each other. The two alternating currents have the same frequencies, but one of them lags behind the other by 90 degrees, and, therefore, the magnetic field of one pair of poles is at its maximum strength when the field of the other pair is at zero, or is neutral. If at any instant, a particular pole of the four poles be a north pole, one of the poles at right angles thereto will subsequently become, at the next instant, a north pole. Then, the opposite pole to that first named will be a north pole, and, at succeeding alternations of the exciting currents, the north pole and necessarily the south pole as well, will be rotated, or progressively shifted, around the armature in a certain direction. In this way a rotary magnetic field is produced in the armature.

Instead of an armature of this type, the armature may be an ordinary Gramme ring armature, but without a commutator, and the two currents may be supplied the windings at points 90 degrees apart (points 180 degrees apart being connected with the same circuit). The combined action of the two currents will set up a rotating magnetic field in the armature, similar to that produced in the armature of a continuous current motor when running.

If a pivoted copper cylinder be placed inside an armature of either of the above types in which there is a rotating magnetic field, the rotation of the field will induce currents in the cylinder, which, according to Lenz's law, will be in such a direction as to oppose the movement of the field. This opposition to the rotation of the field will cause the cylinder to rotate. As a copper cylinder would be unsuitable for use as the field of a motor, this element is usually composed of a cylinder of laminated iron mounted on a shaft. The cylinder is provided with copper windings parallel to its axis, which are connected together in a number of closed circuits. The rotary field induces currents in these closed circuits which oppose the rotation of the field, and these currents thus cause the motor to rotate.

The currents induced in the closed circuits are proportional to the number of lines of force of the rotary magnetic field, which cut them in a given time. The number of lines cut is greatest when the motor is at rest, and becomes less as the speed of the motor increases, until synchronous speed is reached, when no lines cut the closed circuits. For example, if the exciting currents have a frequency of 60 periods a second, when the rotary element of the motor is stationary the closed circuits are cut 60 times by a north field and 60 times by a south field each second. When the rotary element has a speed of 40 revolutions a second, the closed circuits are cut 20 times by a north field and 20 times by a south field each second. The number of lines cut thus varies directly as the difference between the speed of the rotary element of the motor and that of the rotary magnetic field, and, when there is no difference in speed, no lines are cut and no currents are induced in the closed circuits. With no currents in the closed circuits, there is no magnetic field to act upon the rotary magnetic field. The motor, therefore, runs at a speed which is less than that of the rotary magnetic field, the difference between the two speeds being called the magnetic slip. The closed circuits have a very small resistance, so that strong currents are induced in them by the cutting of a comparatively small number of lines of force, and the magnetic slip is therefore small. Anyone can easily satisfy himself that the currents induced when the magnetic slip is small, will produce a strong torque by exciting the field of a continuous current dynamo or motor and short-circuiting the brushes. On turning the armature by hand, the torque will be found to be considerable.

In practice, the variation in speed of a motor of this type between no load and full load is generally from 3% to 5%. From the foregoing explanations it is evident that, if the field of the motor be excited by a continuous current, it will rotate synchronously with the rotary field. Synchronous polyphase motors are constructed on this principle and keep in step with the alternations of the exciting alternating currents even if heavily overloaded. They are self-starting, but do not start readily, and for this reason are not capable of such extensive use as the non-synchronous motors, though they have been found to be preferable for large units. We will therefore confine our attention to the non-synchronous motors.

When a non-synchronous motor is running at full speed, the alternations of magnetism in the field are few, as already explained, and the hysteresis losses in the iron are correspondingly small, but in the armature the alternations of magnetism and the hysteresis losses remain the same as when the motor is stationary. As the rotary element of the motor contains considerably less iron than the stationary element, the hysteresis losses are decreased and the efficiency of the motor increased, by having a rotary armature and a stationary field, so that the most frequent changes of magnetism will take place in the element which has the least iron. But in small motors, and also in large motors where a slight decrease in the efficiency is not of importance, the armature is preferably stationary and the field is rotary, as this arrangement dispenses with collectors and brushes.

The field of a non-synchronous polyphase motor is usually the rotary element of the motor, for then brushes and collectors are not required, as already explained. The field then consists of a laminated iron cylinder mounted on a shaft. A number of stout copper wires or bars are threaded through holes near the periphery of the cylinder and parallel to its axis, or are embedded in slots in the cylinder. By this construction the air gap between the iron of the field and that of the other element of the motor can be made very small, which is essential to efficiency, for, if the magnetic resistance of the air gap be not comparatively low, a large magnetizing current will be required by the motor. The bars or wires are carefully insulated from the cylinder and are connected together at each end to a copper ring, which joins them together in a common closed circuit, or they are connected together in a number of independent closed circuits. When the field is stationary it usually consists of a cylinder or ring of laminated iron in the centre of which is the rotating armature. The windings of the field are arranged and connected together in the same way as when it is rotary, with the exception that the windings are on the inner periphery of the cylinder or ring.

The armature of a polyphase motor is preferably a ring or cylinder of laminated iron somewhat similar to the field core. For, as is apparent from the manner in which the magnetic field rotates around the armature, a ring of iron without projecting pole pieces facilitates the rotation of the field and also avoids injurious reactions caused by the projecting pole pieces. One of the simplest forms of this type of armature is the Gramme ring armature already referred to, which has no commutator and whose windings are supplied with two-phase currents at points 90 degrees apart; points 180 degrees apart being supplied with the same current. The combined action of the two currents sets up a single rotary magnetic field in the armature. The same result is obtained with three-phase currents by supplying the currents to the armature windings at points 120 degrees apart. The drum winding is, however, generally used instead of the gramme winding, and in this case the windings are connected together by conductors arranged around the ring near its periphery. The windings of this type of armature are imbedded in the iron core in the same way as those of the field, and for the same reason, viz: to reduce the magnetic resistance of the air gap. A ring armature of this type can serve as either the stationary or rotary element of the motor. When it serves as the rotary element, the currents are supplied by collectors and brushes.

The armature windings are arranged to produce a greater or less number of poles, according to the speed at which the motor is desired to run. The speed varies directly as the frequency of the exciting currents and inversely as the number of pairs of poles in the armature. For example, if a motor having two pairs of poles, be supplied with four pairs, the rotary magnetic field will then take twice as long as at first to make one revolution, and the speed of the motor will be reduced correspondingly, as it is governed by that of the rotary field. The same result can be accomplished without diminishing the number of poles, by reducing the frequency of the exciting current one-half, which reduces the speed of the rotary field so that it takes twice as long as at first to make one revolution. A motor, therefore, must be adapted to the frequency of the current on which it is to be used, and, in order to have a slow-speed motor without many poles, the frequency must be low. When the speed desired in the motor requires many poles in its field and armature, a stationary armature without projecting poles (similar to the field magnet of a continuous current multipolar dynamo) is generally used instead of the ring type of armature, as it is difficult to get many poles in an armature of the latter type.

The foregoing explanations show that polyphase motors are of an extremely simple construction, consisting only of a rotary and a stationary element of laminated iron with suitable windings, and usually without sliding contacts or brushes. They possess a number of good qualities, among which the most important is probably the absence of a commutator, which must be used with continuous current motors and which requires much attention and is the source of much trouble. The absence of a commutator practically limits the care and attention required by a polyphase motor to oiling the bearings.

The simplicity of construction ensures freedom from repairs as well as facilitates the insulation of the various windings. The closed circuit windings on the field are never subject to an electromotive force of more than a few volts, so that the insulation is not likely to break down. The motors will stand a considerable overload without undue heating, and will also stand considerable abuse without damage. Regarding this point, Dr. Louis Bell, in a recent paper before the American Institute of Electrical Engineers, stated that he had never been able to burn out an armature coil or to seriously injure a polyphase motor by the severest tests.

The non-synchronous motors start with a strong torque and run almost at a constant speed under large variations of load, and compare favorably in these respects with continuous current motors. Tests of polyphase motors of different various sizes show that their efficiencies are equal to those of continuous current motors of the same sizes.

It is no wonder that the two-phase and three-phase systems for the transmission and distribution of electrical energy are attracting so much attention when the good qualities of the motors are taken into consideration in conjunction with the fact that by these systems alternating currents can be furnished for light and power, and in addition continuous currents can be supplied by means of rotary transformers. The polyphase system is thus capable of universal application, as from it can be operated any kind of electrical apparatus for either alternating or continuous current and at any voltage.

THE POSSIBILITY OF SECURING BETTER REGULATION AT CENTRAL LIGHT AND POWER STATIONS BY MEANS OF FLY WHEEL ACCUMULATORS OF IMPROVED CONSTRUCTION.

By John Galt, C. E. and M. E.

The object of this paper is to indicate a simple means whereby considerable energy may be efficiently stored and restored to advantage for central power station purposes.

This at once suggests that a suitable accumulator capable of operating also as a regulator must be introduced.

Energy, as you all know, is only another expression for accumulated work, which may be done either by raising the body a given height, or impressing upon it a given velocity, the first example being the simplest idea of what is meant by the elementary measure of work.

When force acts upon a free body it will of course set it in motion, notwithstanding its inertia, which presents a resistance to be overcome. Thus work is also done in impressing upon a body velocity either linear or circular, one of transition or rotation.

The inertia due to mass is ever present, therefore work can be accumulated or stored up in a rotating wheel as surely as it can be in the ram of a pile driver, the bullet or ball from a gun, or the ponderous head of a steam hammer.

A heavy rotating body as a fly wheel of an engine is simply a reservoir into which the work of the engine can be poured just as water into a reservoir, or some mechanically constructed accumulator, there to be restored when occasion demands.

The following equation gives the estimate of work stored up in a body when moving or rotating with a given velocity.

When a velocity V is impressed on a body of weight W, the work done or stored up

$$= \frac{WV^2}{2g}$$

From this expression we can conclude that the work stored up in the separate parts of a body moving with any given velocity depends upon the square of the distance of each part from the revolving centre of axis of rotation.

For example, one pound or one ton weight 3 feet from the axis of rotation has nine times as much work stored up as the same weight at a distance of 1 foot, provided the angular velocity is the same in both cases.

There are very many examples in the arts of accumulating work by simple mechanical means, similar in principle to the one which I now propose for consideration.

The flywheel press which is used for cutting and punching material or stamping coin consists merely in the application of a revolving lever or wheel weighted at the ends, or the heavy revolving flywheel in a shearing or punching machine has the same principle applied for accumulating energy to assist in carrying the prime mover over its hardest work.

Take the case of the tiny sewing machine, whether driven by hand or foot. When the wheel is turned rapidly it runs steadily and uniformly, notwithstanding that the driving force is variable; this exhibits largely the function of a flywheel for ordinary purposes.

From what I have already stated a good deal may easily be learned about the nature of a flywheel.

Suppose two wheels exactly alike attached to each other on the same shaft, so as to make practically one wheel of double the weight, then the work stored up for any given speed per minute is doubled, thus showing the influence of weight alone.

Let, however, the speed be doubled by increasing the number of revolutions in a given time, or by increasing the diameter of wheel, then the work stored up is four times as great.

This latter case emphasizes the great importance of velocity.

Reverting to the original formula representing the energy stored in flywheel, viz.: $E = \frac{WV^2}{2g}$ then by differentiating $\Delta E = \frac{WV}{g} \Delta V$ or $\frac{g}{WV^2} \Delta E = \frac{\Delta V}{V}$ which is the fluctuation of velocity, and it is the function of the flywheel to keep this down within small limits. This fluctuation may arise either from variations in the effort exerted by the prime mover or from variations in the load or resistance, or it may arise from both these causes combined.

When one flywheel is used it should be placed in as direct connection as possible with that part of the mechanism where the greatest amount of fluctuation originates; but when it originates at two or more points it is best to have a flywhel connected to each.

We can readily see from the original formula that a flywheel running with a considerable rim velocity can store a very considerable amount of energy.

Take for example a wheel having a rim velocity of 75 feet per second, and weighing, say 20 tons:

$$\text{Energy of rim} = \frac{20 \times 75^2}{2g} = 1747 \text{ foot tons}$$

$$\text{Expressed in horse power minutes } \frac{1747 \times 2240}{33{,}000} \quad 118.6 \text{ P.}$$

$$\text{Or direct from original equation } \frac{WV^2}{948.8} \quad 118.6 \text{ P. minutes}$$

This represents the ordinary safe speed of the present best design of cast iron flywheels. Now if improved flywheel construction will secure an increase of speed say to 150 or 300 feet per second, the energy stored would of course be four times and sixteen times greater, viz., 500 to 2,000 horse-power minutes respectively, as against, say 120 horse, with a similar proportionate increase of energy available and ready to be restored for regulating purposes.

Column 2 of table I. shows the total amount of energy stored for different rim velocities for each ton weight of rim.

The energy is expressed as horse-power minutes instead of foot tons or foot pounds—in other words, if the energy of the flywheel were all used up in one minute the horse power given out would be the number there stated.

Flywheels of the ordinary type in use occasionally fly to pieces without giving the slightest warning, making an utter wreck of the station, besides being very often accompanied by loss of life.

Of late years these accidents have become very numerous, and the reason is simply this, that prime movers and flywheels are called upon now to perform much harder duty than formerly, and any one who has studied the present requirements, especially for central power station work, must be more than convinced that some improvement in the line I am pointing out would be of immense advantage. Little or no improvement in the design and construction of flywheels has taken place since the introduction of the steam engine, and this is all the more remarkable when we consider the many improvements which have taken place in almost every other direction and detail of mechanical science.

The consensus of opinion of both mechanical and electrical engineers and experts everywhere may be summed up in the statement by Dr. Edward Hopkinson, of London, England, in his late paper on Electrical Railways, viz:

"If an efficient accumulator, capable of working as a regulator, could be introduced, it would be possible to reduce the capacity of a generating plant by at least 35 to 40 per cent., and at the same time considerably increase its efficiency. Such an accumulater I venture to suggest is to be found in better wheel construction. With any electric railway on which there are a number of cars it always happens that at frequent close intervals of time the load is very much beyond the average power required."

The generating plant at the central station must of course be of sufficient capacity to meet the largest demand which may be made on it. Consequently without some source of accumulated energy to fall back upon, the prime movers must be made larger in order to handle with certainty the maximum loads.

Both in Europe and America the subject of improved flywheel construction is now beginning to receive the attention its importance deserves.

The central station of the Union Railroad Company, from which are run all the trolley lines of Providence, R. I., has lately installed cross-compound engines, with direct connected generators on engine shaft, having specially designed flywheels, the main object being the prevention of accidents, which have recently been of frequent occurrence.

Mr. Sheldon the engineer, believed that he could make a wheel which would be absolutely indestructible, and prevailed upon the directors to insure themselves against the flywheel epidemic, by building it entirely of wrought iron and steel, with a large margin of safety—no attempt or claim, however, being made to secure better accumulation of energy, and consequent steadier regulation.

Its design and construction will be apparent from the drawings reproduced and illustrated in Fig. 1.

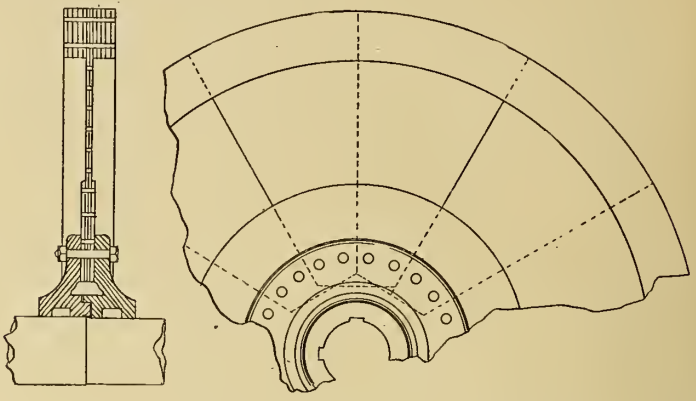


FIG. 1.

The steel rim is attached to a plain steel disc, which takes the place of arms or spokes, the whole being connected to shaft as shown by means of cast iron hub or nave.

This wheel, which must have cost a very great deal of money, has not been built to act in any better capacity as a regulator than the ordinary cast iron flywheel, and it surprises me that it was not designed and proportioned to operate also as a powerful wheel by merely increasing its rim velocity, even at the expense of a reduced factor of safety, which at 40 is altogether too high for requirements of safety alone, especially when wrought iron and steel is used, and not cast iron, which at the best is a most uncertain metal.

That there is a want for a powerful but light flywheel will be generally admitted

Some advocate heavy flywheels because of their power, others again condemn them because of their weight.

A powerful flywheel of ordinary design, meaning a heavy flywheel, has placed engineers between the devil and the deep sea.

Now a powerful and light flywheel deriving its power from its high speed should satisfy both sides.

In prosecuting my enquiries I find that already a very good practical solution of this problem has been suggested.

Prof. Sharp, B. Sc., Wh. Sc., etc., a distinguished mathematician and engineer, of London, England, has taken up this subject, and actually invented and patented within the last month or so a new method of wheel construction, which appears to exactly fill the bill. This improvement covers the entire ground, and strange to say, is applicable to all kinds of wheels from the perambulator and bicycle wheel up to the pulley for power transmission, as well as large flywheels.

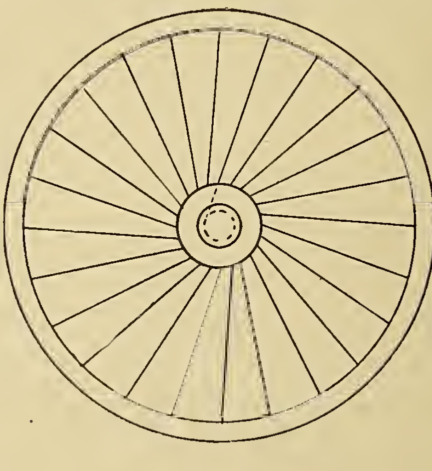


FIG. 2.

Having made this discovery, I at once entered into correspondence with Prof. Sharp, and have his letter of last month (August), stating that he is now arranging to have his new design introduced in some important contracts.

I am much indebted to him for his pamphlet giving a pretty accurate and full description of this new system of wheel construction, together with rules and formula on the "*Theory of the New Flywheel.*"

The principle of this new construction proposed is based upon the use of steel spokes instead of arms or disc, these spokes being tangent and attached respectively to the rim and nave.

This feature of tangent spokes, now so well and favorably known in bicycle wheel construction, is, it seems to me, one which can be advantageously applied and extended generally to all kinds of wheels, and it is in this direction where mechanical accumulators may be looked for. When any wheel built with radial arms or spokes is at rest, their direction passes through the centre of the hub, but when a driving effort is exerted, the direction at once changes, and instead of passing through the centre of the hub, passes along tangent to a small circle as illustrated in Fig. 2.

This action causes continual bending to and fro of the spoke at the point where it leaves the hub and the stresses induced by bending are much greater than those due to the direct tension of the spokes. In fact a wheel with radial spokes is not a rigid structure, for before it can be driven the hub has to be moved through a small circle relative to the rim. If the direction of driving is reversed, the hub must first return to its original relative position and then be displaced an equal amount on the opposite direction before driving can take place. To obviate this injurious action, tangent spokes have been introduced of late into bicycle and other classes of wheel construction, and there is no good reason why this design should not be adopted for wheel construction generally and especially for pulleys and flywheels. These tangent wheels are built with the spokes such that they all permanently touch a certain fixed driving circle. Half of the spokes are inclined in one direction and half in the opposite.

In a wheel constructed with spokes tangent to the driving circle, when the driving effort is exerted, the tension of one half of the spokes is increased and that of the other half diminished.

Theoretically, then, a tangent wheel is much better than a direct or radial spoke wheel, since it approaches more nearly to a rigid structure, as the angle of displacement of the hub relative to the rim being very small and due entirely to the stretch of the spokes caused by tension due to driving effort.

A heavy flywheel which is too large to be cast in one, or two half pieces, is usually built up, the rim being cast in segments and the arms also of cast iron carefully fitted at one end to the nave and at the other to the segments of the rim, or in some cases the arms are cast on as part of the rim segments and only require attaching and fitting to the nave.

The cost of constructing a large flywheel in this way is very great.

Fig. 3 is a section of the rim with spokes attached for a flywheel pulley to be built in segments on the new system.

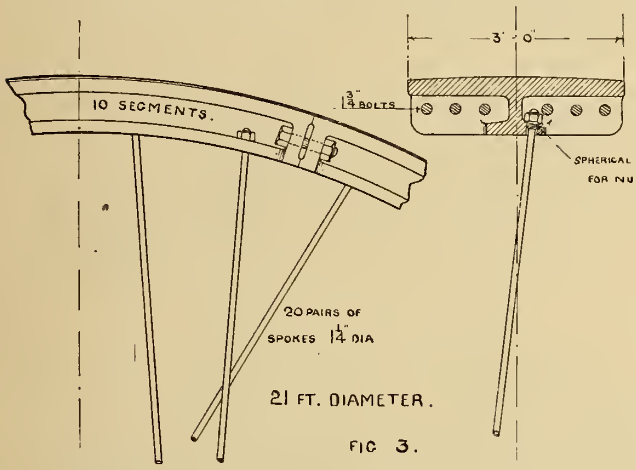


FIG 3.

With ordinary cast iron wheels the speed must not exceed a certain limit, as the centrifugal force due to the rotation produces forces on the rim acting radially outward; these are balanced partly by the tension on the arms and partly by circumferential tension on the rim; these combined forces produce bending on the rim similar to a beam uniformly loaded and fixed at supports, as shown in Fig. 4.

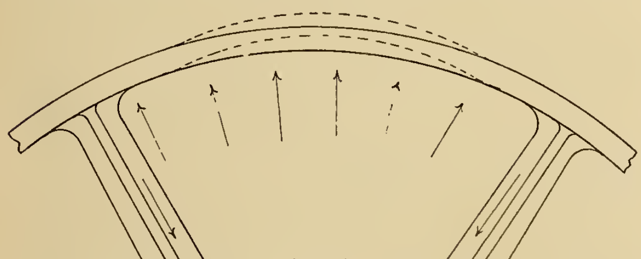


FIG. 4.

The exact amount of the stress due to this bending moment is difficult to determine, but that it is very much greater than the circumferential tension on the rim is proved by the fact that a linear speed of rim of 100 feet per second (which is the highest speed allowable for a large flywheel), the circumferential tension on the rim is only ½ ton per square inch, whereas the breaking tensile strength of cast iron is from 10 to 12 tons. Thus the stresses on the rim due to bending caused by the pull of the arms at a few points only, must certainly be very great.

In flywheels with numerous steel spokes, Figs. 3 and 8, there is no very great length of rim unsupported, consequently this bending action is almost entirely eliminated, and therefore a much higher speed can be used with safety.

In wheels with radial arms the arms or spokes which are straight when the wheel is at rest will each be bent as shown, exaggerated at *a b* (Fig. 5), when the effort is being transmitted from the nave to the rim in the direction indicated by the arrow. If the direction of driving be reversed, or if the driving effort be lessened, and the rim overruns the nave the arms will be bent as shown by dotted line at *a b*.

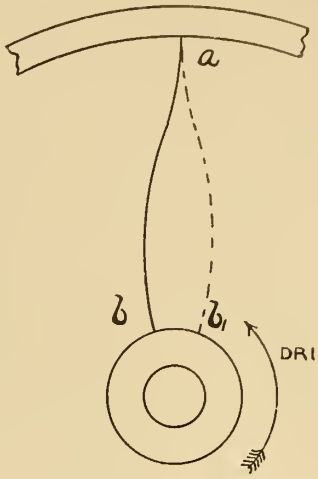


FIG. 5.

It will be seen therefore that radial spokes constitute a slightly flexible coupling between the rim and nave of the wheel, so that the rim may be moving with practically uniform velocity while the fluctuation of velocity of the nave may be considerable, whereas the action of the tangent spokes, being a rigid structure, is entirely different.

In continuing the consideration of this subject further, I will refer almost entirely to Prof. Sharp's system of wheel construction, because I find he has provided for the difficulty of attaching spokes to nave by a simple and efficient method of winding spokes in pairs around the nave in helical friction grooves.

The distinctive features of Prof. Sharp's new system of wheel construction are illustrated in Figs. 6 and 7.

The nave or hub of the wheel is attached to the rim by a series of loops of iron or steel, one loop forming a pair of spokes.

Fig. 6 illustrates the elevation of a wheel with 24 spokes in 12 pairs. One loop or pair of spokes is shown thickened.

The ends of spokes are fastened to the rim by means of nuts or nipples in any usual way.

There is absolutely no fastening of the spokes to the nave beyond that due to friction.

The ends of all spokes may lie in one plane, but as the spokes approach the nave they are spread out latterly in a similar manner to that usually seen in bicycle wheel

Fig. 7 is a section through the nave and rim and shows the lateral spread of the spokes; the nave surface may have a single or multiple screw according to the requirements.

The pair of spokes *a*, *a'*, Fig. 8, is shown having an arc of contact with the nave of nearly half a turn, the part of the loop *a*, *a'*, in contact with the nave, is formed spirally so that all ends of the spokes on one side of the middle plane begin contact with the nave at the same distance from the middle, and the other ends leave the nave nearer the centre or middle plane, Fig. 7.

In the wheel illustrated in Figs. 6 and 7 there are twelve pair of spokes, six pair being on each side of the centre or middle plane, so if the parts in contact with the nave lie in grooves, these grooves will form practically a six-threaded screw on the nave surface.

The arc of contact of each pair of spokes with nave may of course be varied. Thus keeping the end *a* fixed in the position shown in Fig. 6, the end *a'* could be taken to the place occupied by a'^{2}.

By making the spokes have a spiral arc of contact with the nave as described above, the positions of all the spokes relative to the nave are exactly similar, and thus the wheel is symmetrical, and the spokes are all of exactly the same length.

This would not be the case if the arcs of contact were circles whose planes were perpendicular to the axis of the wheel, as the middle points of each of the pairs of spokes would then all lie at different distances from the middle plane of the wheel.

The nuts or nipples fastening the spoke ends to the rim being screwed up until the necessary tension is on the spokes, there is ample friction between the spokes and the nave to prevent any relative movement, while the angle at which the spokes leave the rim remains always the same, consequently there is no injurious wrenching action on the rim joints.

The rim joints can therefore give no trouble, however severe the work to be done by the wheel.

In Sharp s wheels the action of the spokes is illustrated in Fig. 10, and shows the relation of the pair of spokes to the nave and rim. When transmitting effort from the nave to the rim, in the direction indicated by the arrow, the pull F_a on the portion *a b* of the pair of spokes is a little greater than the initial pull, while the pull F_d on the portion *d c* is a little less than the initial pull. The difference between F_a and F_d is taken up by the frictional grip of the portion *b c* on the nave. The difference ($F^a - F^d$) multiplied by *r*, the radius of the hub, gives the twisting moment transmitted per pair of spokes Or the forces F_a and F_d, acting at *a* and *d* respectively, may be resolved into radial and tangential components T_a, R_a, and T_d, R_d respectively. The radial components R_a and R_d have no effect in accelerating or retarding the motion of the rim, so the resultant force accelerating the rim is $(T_a - T_d)$ per pair of spokes.

Now, in a flywheel, suppose the effort at any instant to fall below the average resistance, as would be the case near the beginning and end of each stroke of the engine, the pull F_d on the portion *d c* would become greater than the pull F_a on portion *a b*, and the rim of the flywheel would supply to the nave the momentary deficiency of effort. The only effect of this slight variation of stresses on the portions *a b* and *d c* of the spokes is that they are slightly elongated, the elongation being so small that the whole wheel—rim, spokes, and nave—constitutes a practically rigid structure. Thus for a variation of stress of 1 ton per square inch, taking E, Young's modulus, 10,000 tons per square inch, the spokes will stretch periodically $\frac{1}{10000}$th part of their length. In a wheel 20 ft. diameter this periodic stretch of the spokes will be

$$\frac{10 \times 12}{10000} = \cdot 012 \text{ in.}$$

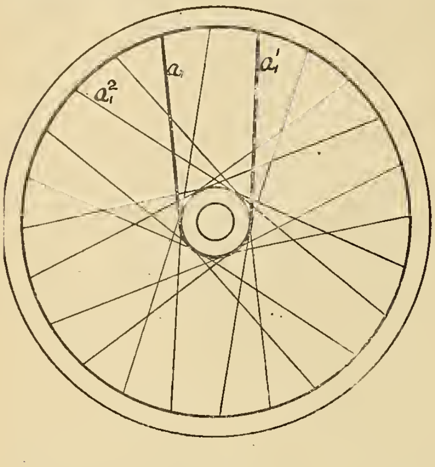


FIG 6.

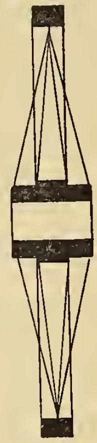


FIG. 7.

As regards the staunchness of the joints between the rim and spokes, the case is infinitely better than in the radial spoke wheel. Whatever be the stretch of the spokes, they must always touch the nave circle of radius *r*. Thus the angle at *a* or *d* at which the spokes leave the rim remains always the same, and there is consequently no wrenching action on the rim joints.

Fig. 8 shows description of a high speed flywheel according to the new method of construction, Fig. 9 showing enlarged section of rim.

An exactly similar method of construction can be applied to flywheel pulleys where too large to be cast in one piece, as illustrated in Fig. 3; the spokes and nave can be designed in a similar way to fig. 8 with 10-threaded screws.

This cast iron pulley (see Fig. 3) is 21 ft. in dia. and has $1\frac{1}{4}$ in. spokes. The rim is in segments of cast iron and weighs in all 16 tons, nave 1 ton, and spokes ·7 tons; these proportions of course will vary according to the requirements of design for different speeds.

In order to illustrate more pointedly and fully the applications of these new designs let me take first the example of a gas engine working with the Otto cycle, the excess energy of which is very large, and to run steadily they must have very powerful flywheels.

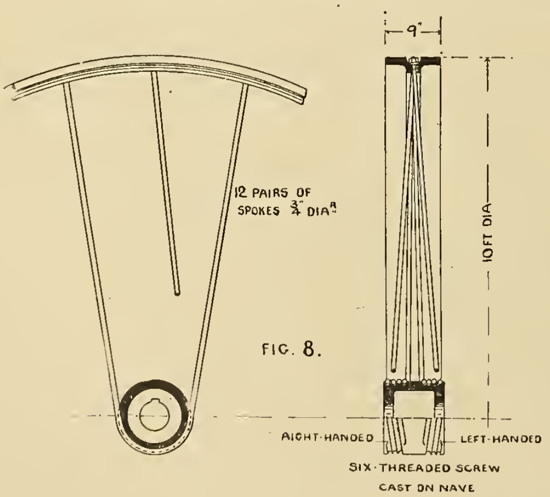


FIG. 8.

For electric lighting purposes a gas engine is sometimes employed to drive a dynamo direct.

As an example, suppose a dynamo to make 240 revolutions per minute or 4 revolutions per second with a flywheel cast in one piece, taking the safe rim velocity to be 80 ft. per second, its diameter would be 6·3 feet.

With a wheel built on the new system, the weight of rim being the same as before, if the diameter were increased to 19 ft., the velocity would be trebled, and the fluctuation of velocity would be reduced to one-ninth part of its original value.

The governing of gas engines is obtained almost altogether by cutting out explosions. So that with say half load (a necessity which exists often in central lighting stations), an explosion would only take place every three or four revolutions, causing great irregularity of running, unless specially provided against.

What was wanted, therefore, was a gas engine that would give about as good and regular turning movement as the double-acting steam engine, and which might in most cases be easily coupled direct to the dynamo.

By introducing a powerful fly wheel, say of increased weight and speed, a very steady effect could be secured, and if gas engines had always been provided with such flywheel accumulators, there would have been little trouble with belts and unsteadiness of currents from dynamos.

Column 2 of table I. shows the amount of energy stored for different velocities for each ton weight of rim.

Table I. has been carefully calculated and will be found most useful for designing fly wheel accumulators to satisfy given conditions.

The available energy per ton weight of rim for a total fluctuation of 10% will be found in column 3. If, however, still closer regulation is desired for special cases, then to provide for a total fluctuation of only 5%, *i.e.*, $2\frac{1}{2}$ per cent. above and $2\frac{1}{2}$% below the average, then column 3 divided by 2 will give the horse-power minutes of energy available, and of course column 4 would require to be just doubled; the remaining columns, however, would remain unaltered.

By way of illustration, let me take another example where the extra power required at the generating station, corresponding with the starting of cars or running on up grades, etc., would be about 50 to 60 horse-power minutes.

From column 3 it will be seen that if a flywheel accumulator be built to run at a speed of 300 feet per second, with a weight of 3 tons in the rim, and with an allowance for a maximum fluctuation of velocity of 5% above and 5% below the average, this will supply the 60 horse power required.

Thus the engine and boiler plant may be of capacity corresponding to the average power required, provided this flywheel accumulator be used.

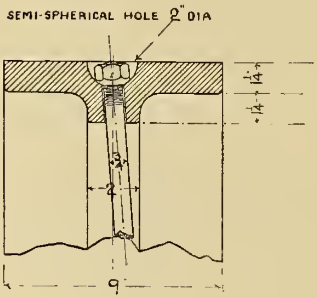


FIG. 9.

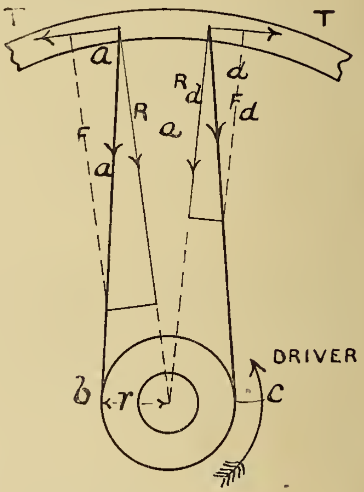


FIG. 10.

Thus when a sudden increase of load occurs the engine will be developing less power than that required at the moment, and the speed will diminish.

During this diminution of speed the flywheel delivers up energy corresponding to the difference between the power required and that developed by the engine at the instant. This diminution of speed goes on until the demand for power at the station falls below that being developed by the engine.

The speed of the engine will now increase slightly, and additional energy will be stored in the flywheel.

Besides reducing the size of the engines and boilers at the station, such an arrangement will allow the engines to work steadily at or near their best maximum capacity, which is most important and advantageous where economy of steam consumption is concerned.

The mechanism of the engine is subjected to far less stress since there is no violent fluctuations of speed, and the governor gear may in many cases be reduced to the simplest type; thus permitting often considerable increase in the number of revolutions per minute of engine, which would assist somewhat in securing the necessary higher rim velocity of flywheel.

In many cases a flywheel might also be attached direct to the dynamo shaft, with some suitable friction interposed between it and dynamo, so that in case of short circuiting the armature of the dynamo might be pulled up while the flywheel continues to revolve, thus merely corresponding to the breaking of the belt in the case of a belt-driven dynamo.

Taking a speed for a dynamo shaft to be 600 revolutions per minute, a wheel $11\frac{1}{2}$ feet in diameter would give the necessary rim velocity of 300 feet per second, and for the requirements of last example give the necessary 60 horse-power minutes of available energy.

From an examination of load curves from several power stations taken from meter readings, the period of time from average to maximum load seldom exceeds one minute, and in average-sized and well-developed railway systems this period is very much reduced, and falls within 15 seconds.

The load curve for example from the Toronto Street Railway power station showed at one time a fairly uniform load line of 2,000 average horse power, the readings being taken, I think, every 15 minutes, and even then the ordinary average was tabulated after all the violent and momentary fluctuations on ampere meters had ceased.

Had the load curves been drawn out to readings of 15 seconds instead of 15 minutes, the variations would have been clearly marked; as it was, however, I found that within periods of half minutes, more or less, the extra power required varied from 20 to 30 per cent. above the average, viz., from 2,000 to, say, 2,500 horse power. And it would be further apparent to any observant mechanic that the entire machinery in the station from the revolving armature in the generators, down through the mechanism of the engine and its governing gear to the very steam inlet valves of cylinders, and along through steam pipes to the water in boilers, had to accommodate themselves directly to this sudden demand upon them, simply because there was no form of accumulated energy attached to the driving machinery to fall back upon in order to carry it over the momentary maximum load resistance.

The engines in this station are five in number, each of say 500 horse power, of the Armington & Sims design, cross compound with double cast-iron flywheel pulleys, each 8 feet in diameter, and revolving at about 275 revolutions per minute, belted direct to generators for a much higher speed.

For the purpose of comparison it will be sufficiently near the truth to assume that both flywheel pulleys have rims both weighing together about 4 tons, running at 100 feet per second. This, according to table, will give 40 horse-power minutes, and with a total variation of 2½ per cent. above and below the average speed, the total available enery will be 4 horse-power minutes, or a total available energy for road regulating purposes over the entire 5 engines in station of 20 horse power.

This amount is of course entirely inadequate for anything beyond the mere work and the functions of an ordinary flywheel.

You will now appreciate the value and importance of having accumulators, designed for storing and restoring from 20 to 30 per cent. extra power beyond the average requirements, and you can also understand that there is no difficulty or trick about having flywheel accumulators attached to properly handle such conditions, especially as additional wheel accumulators could be applied to the generator shafts as well as to the engine shafts if necessary.

This plant, by way of comparison, as it stands, therefore, should be good for an average of about 2,500 horse power, but if designed with proper flywheel accumulators it could handle with ease an average of 3,000 horse.

Now, coming to the case where generators are connected direct to engine shaft, the problem is much easier and cheaply solved when the speed runs from 300 up to 600 revolutions per minute, but when the rotative speed is down as low as 100 revolutions per minute, the problem of attaching efficient and suitable flywheel accumulators becomes much more difficult and costly.

What I have said already will fully explain and provide for the case of direct connected high rotative-speed generators, but by way of variation let us consider the case of slow-speed generators, for example, the large horizontal cross compound Corliss engines of 1,200 horse power being built for the Toronto Railway Company, to the engine shaft of which the generators are attached.

Each of these engines is provided with a specially built-up flywheel, 20 feet in diameter, and having an effective rim weight of say 30 English tons, now running at 90 revolutions per minute, or 1.50 per second, the rim velocity will be 90 feet per second.

The total energy stored in flywheel

$$= \frac{WV^2}{948.8} = 250 \text{ horse-power minutes.}$$

Giving 25 horse-power available energy, corresponding to

$$\frac{\Delta V}{V} = \frac{1}{20} \text{ for regulating.}$$

Here also it is at once apparent how helpless this flywheel is to permit of a sudden variation of load without calling upon the entire mechanism and governing gear of engine to act and react, so as to control the proper distribution of steam.

In other words, as there is no great accumulated energy the engine indicator cards will vary very much in the same degree as the load resistance.

Although the weight of revolving armature, etc., will add to the energy stored, the engine will still be subject to the varying stresses due to the continually changing load.

Now suppose one or two flywheels of the same weight were built to run at double this velocity, or better, say 200 feet per second, the total available energy for the above fluctuation would be increased to 250 horse power, or fully 20 per cent. beyond the average power of engine, viz., 1,200 to 1,450 horse power.

In other words, the engines as designed will average normally 1,200 horse, whereas with engines designed for 125 revolutions per minute, with two flywheel accumulators would give a working average of about 1,500 horse, with greater ease and much better results as to economy.

The following theory of the new flywheel by Prof. Sharp, with certain examples and cases worked out, will be found most useful and valuable for reference:

THEORY OF THE NEW FLYWHEEL.

Let W = total weight of rim in tons
W^1 = weight of spokes
V = average velocity of rim in feet per second
E = kinetic energy stored in rim in foot-tons
N = kinetic energy stored in rim H.P. minutes
N^1 = Available H.P. minutes corresponding to η
r = the radius of the rim in feet
f = tensile stress on the spokes, tons per square inch
a = angular velocity of wheel
ΔV = difference between maximum and minimum velocities
$\eta = \frac{\Delta V}{V}$ = fluctuation of velocity
s = weight of 1 ft. length of spoke, 1 square inch section = 3·38 lb. = ·00151 tons
a = sectional area of a spoke, square inches
w^1 = weight of one spoke.

Energy of Rim.—

$$E = \frac{WV^2}{2g} \quad . \; . \; . \; . \; . \; . \; . \; . \quad (1)$$

Differentiate, then approximately $\Delta E = \frac{WV}{g} \Delta V$

$$= \frac{WV^2}{g} \frac{\Delta V}{V} = \frac{\eta WV^2}{g} = 2\eta E \quad . \; . \; . \; . \; . \; . \; . \quad (2)$$

$$N = \frac{2240E}{33000} = \frac{WV^2}{948.8} \quad . \; . \; . \; . \; . \; . \; . \; . \quad (1b)$$

$$N^1 = 2\eta N = {\cdot}1358\,\eta E \quad . \; . \; . \; . \; . \; . \; . \; . \quad (2b)$$

Energy of Spokes, considered radial.—Consider a small piece of a spoke of length dx, and distant x feet from the centre of the shaft; its weight will be $s\,a\,dx$, its velocity ax, and therefore its kinetic energy stored in it is $\frac{s\,a\,a^2\,x^2}{2g}\,dx$.

The kinetic energy stored in one spoke will be

$$\frac{s\,a\,a^2}{2g}\int_0^r x^2\,dx = \frac{s\,a\,a^2\,r^3}{6g} = \frac{w_1 V^2}{6g} \quad . \; . \; . \; . \; . \; . \quad (3)$$

Thus the kinetic energy stored up in the spokes is one-third that due to their weight, if concentrated at the rim.

Centrifugal Tension in Spokes, due to weight of rim only.—Suppose that the centrifugal force of each element of the rim is transmitted to the spoke, so that when the flywheel is revolving there is no circumferential tension of the rim. Then the total tension on the spokes is—

$$\frac{W\,V^2}{g\,r} = \frac{2\,E}{r} \text{ tons} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \quad (4)$$

The total sectional area of the spokes will be

$$\frac{2\,E}{r\,f} \text{ square inches} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \quad (5)$$

The total weight of spokes is—

$$\frac{2_s\,E}{f} = \frac{E}{331f} = \frac{WV^2}{21340f} = \frac{N}{22{\cdot}47f} \quad . \; . \; , \; . \; . \quad (6)$$

Thus from (6) it seems as if the centrifugal forces due to the weight of the rim be entirely taken up by the spokes, the necessary weight of the latter depends only on the kinetic energy to be stored in the rim, and on the working stress to which the spokes are subjected.

Centrifugal Tension in Spokes, due to their own weight only.—Suppose that the forces due to the weight of the rim are balanced by a circumferential tension in the rim, as in the case of a plain ring revolving about its geometrical centre. The tension in a spoke will then be due to its own weight. Consider a spoke of 1 square inch sectional area; an element of it distant x feet from the centre, and of length dx, will have the weight $s\,dx$, and the velocity ax. The tension in the spoke balancing the centrifugal force of this element is $\frac{s\,a^2\,x}{g}\,dx$.

The total tension at the centre (considering the spokes radial) will be

$$\frac{s\,a^2}{g}\int_0^r x\,dx = \frac{s\,a^2\,r^2}{2g} = \frac{s\,V^2}{2g} = \frac{V^2}{42800} \text{ tons per sq. in.} \quad . \; . \quad (7)$$

In the limiting case, when the stress due to centrifugal force of spoke is equal to f, the safe tensile resistance of the material, we have $V^2 = 42800f$. If the value of f must not exceed 10 tons per square inch, V must not exceed 654 ft. per second.

Circumferential Tension in Rim due to its own weight.—If the centrifugal forces due to the weight of the rim are balanced by a circumferential tension in the rim, this tension is (see Unwin's "Machine Design")

$$\frac{s\,V^2}{g} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \quad (8)$$

Table I. has been calculated from the above equations, and is useful for designing a flywheel to satisfy given conditions.

Case in which the Centrifugal Forces due to Weight of Rim are Balanced partly by Circumferential Tension in Rim, and partly by Tension in the Spokes.—A numerical example will perhaps illustrate the treatment of this case most clearly.

Suppose the rim velocity to be 300 ft. per second, the stresses in rim and spokes at this speed to be 3·5 and 5·10 tons per square inch respectively. (These two values of the rim and spoke stresses must be, of course, assumed, respectively, lower and higher than the values given in the table.)

The tension on the spokes due to their own weight is, from equation (7), or from the table, 2·10 tons per square inch, leaving 3 tons per square inch tension on the spokes to resist centrifugal forces of the rim. Let W_1 be the weight of the part of the rim whose centrifugal forces are taken up by the spokes, then from equation (6) the weight of spokes is

$$\frac{W_1 \times 300^2}{21340 \times 3} = 1{\cdot}406\,W_1$$

Let W_2 be the weight of the part of the rim whose centrifugal forces are resisted by the circumferential tension of the rim. If this tension existed only over the part W_2 of the rim, it would, from equation (8), or from the table, be equal to 4·20 tons per square inch. Being spread over the whole rim $W_1 + W_2$ of the intensity, 3·5 tons per square inch, we have

$$3{\cdot}5\,(W_1 + W_2) = 4{\cdot}2\,W_2$$

from which $$W^2 = 5W_1$$

Thus taking $W_1 = \frac{1}{2}$ ton, W_2 will be $2\frac{1}{2}$ tons, the total weight of rim will be 3 tons, and the weight of spokes ·703 tons.

The energy stored, from equations (1 *b*) and (3), is

$$\frac{3{\cdot}234 \times 300}{948{\cdot}8} = 306{\cdot}7 \text{ horse-power minutes.}$$

TABLE I.

Velocity of rim. V	Total energy stored per ton weight of rim. N	Available energy per ton weight of rim, $\eta = \frac{1}{10}$. N'	Weight of rim required for 100 H.P. minutes available energy, $\eta = \frac{1}{10}$.	Ratio of weight of spokes to weigh of rim, $f = 5$ tons per sq. in.	C'ntrifugal stress in rim due to its own weight.	C'ntrifugal tension in spokes due to their own weight.
Ft. per sec.	H.P. mins.	H.P. mins.	Tons.		Tons per sq. in.	Tons per sq. in.
50	2·63	·527	189·7	·023	·117	·058
100	10·54	2·108	47·43	·094	·469	·234
150	23·71	4·742	21·08	·211	1·05	·525
200	42·15	8·43	11·86	·365	1·87	·935
250	65·87	13·17	7·59	·585	2·92	1·46
300	94·85	18·97	5·27	·843	4·20	2·10
350	128·9	25·82	3·87	1·15	5·73	2·84
400	168·6	33·73	2·96	1·50	7·48	3·74
450	213·0	42·69	2·34	1·89	9·47	4·73
500	263·5	52·70	1·897	2 34	11·68	5·84

Provided the initial tension on the spokes be correctly adjusted, the stresses on the rim and spokes would be 3·5 and 5·10 tons per square inch, while the wheel runs steadily with a rim velocity of 300 ft. per second. Taking the number of revolutions per minute 500, the diameter of the rim would be

$$\frac{300 \times 60}{500\,\pi} = 11.5 \text{ ft.}$$

Circumference of rim $= 36$ ft.

Section of rim $= \frac{3}{{\cdot}2174 \times 36}$ square feet,

.2174 tons being the weight of a cubic foot of wrought iron— that s, the section of the rim would be 55·2 square inches.

The total sectional area of the spokes is

$$\frac{{\cdot}703 \times 144}{{\cdot}2174 \times 5{\cdot}75} = 91 \text{ square inches ;}$$

say 48 pairs of spokes $1\frac{1}{16}$ in. diameter.

Initial Tension on the Spokes.—Let A_s be the total sectional area of spokes (that is, equal to the sectional area of each spoke multiplied by twice the number of pairs of spokes), let A_r be sectional area of rim, f_s and f_r the tensile stresses on the spokes and rim respectively when the flywheel is running at its proper speed, F_s and F_r the corresponding stresses when the flywheel is at rest. Then, evidently,

$$A_s\,F_s = 2\,\pi\,A_r\,F_r \quad . \; . \; . \; . \; . \; . \; . \quad (8)$$

the negative sign on the right-hand side of the equation indicating an initial compression on the rim corresponding to an initial tension on the spokes. When the flywheel is running, its radius will be slightly larger than when at rest. Let $x\,r$ be the increment of the radius, E_r and E_s the moduli of elasticity of the rim and spokes respectively. Then the additional tensile stress on the spokes, due to the increment of the radius, will be $x\,E_s$, and the additional tensile stress on the rim will be $x\,E_r$. Therefore

$$f_s = F_s + x\,E_s \; . \; . \; . \; . \; . \; . \; . \quad (9)$$

$$f_r = F_r + x\,E_r \; . \; . \; . \; . \; . \; . \; . \; . \quad (10)$$

Eliminating x from (9) and (10) we have—

$$(f_s - F_s)\,E_r = (f_r - F_r)\,E_s$$

or, substituting for F_r its value from (8),

$$(f_s - F_s)\,E_r = \left(f_r + \frac{A_s\,F_s}{2\,\pi\,A_r}\right) E_s \; . \; . \; . \quad (11)$$

or, $$F_s\,(2\,\pi\,A_r\,E_r + A_s\,E_s) = 2\,\pi\,A_r\,(f_s\,E_r - f_r\,E_s).$$

If the maximum stresses on the spokes and rim f_s and f_r be given, equation (11) serves to determine the proper initial tension F_s to be put on the spokes.

In the example worked out above, $f_s = 5{\cdot}10$ tons per square inch, $f_r = 3{\cdot}5$, $A_s = 91$, $A_r = 55{\cdot}2$, and equation (11) becomes

$$F_s\,(2\,\pi \times 55{\cdot}2 + 91) = 2\,\pi \times 55{\cdot}2\,(5{\cdot}10 - 3{\cdot}5).$$

From which $$F_s\,(346{\cdot}8 + 91) = 346{\cdot}8 \times 1{\cdot}6$$

$$F_s = 1{\cdot}26 \text{ tons per square inch.}$$

The corresponding initial compression on the rim will be—

$$F_r = \frac{91 \times 1{\cdot}26}{2 \times 55{\cdot}2} = {\cdot}33 \text{ tons per square inch.}$$

Friction between Spokes and Nave.—Let f be the tensile stress in tons per square inch on the spokes when the flywheel is running steadily.

During acceleration of the flywheel rim let the stress on one end of each pair of spokes rise to f_1 while that on the other end falls to f_2. Let θ = arc of contact of spoke and hub, and u the coefficient of friction. The horse power required to accelerate the rim is

$$\frac{2240}{550}\,(f_1 - f_2)\,\frac{A_s}{2}\,.\,\frac{R\,V}{r} \quad . \; . \; . \; . \quad (12)$$

R being the radius of the hub. If the spokes are just on the point of slipping on the hub,

$$\frac{f_1}{f_2} = e^{u\theta} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (13)$$

Assuming that $f_1 + f_2 = 2f$ . . . . (14)

From (13) and (14),

$$f_2 = \frac{2f}{e^{u\theta} + 1}, \quad f_1 = \frac{e^{u\theta}}{e^{u\theta} + 1}\,2f.$$

Substituting in (12)—

$$\text{H.P.} = 4{\cdot}07\,\frac{f\,A_s\,R\,.\,V}{r}\left(\frac{e^{u\theta} - 1}{e^{u\theta} + 1}\right) \; . \quad (15)$$

an equation giving the maximum power that can be transmitted to the flywheel rim.

If the power transmitted at any moment be less than that indicated by equation (15), there will be no slipping of the spokes on the nave.

In the example worked out above (fig. 16,) taking u for iron on iron (dry surface) 0.2, and an arc of contact of $1\frac{1}{2}$ right angles, $\theta = 2{\cdot}356$ and $e^{u\theta} = 2{\cdot}603$. Equation (15) becomes

$$\text{H.P.} = \frac{4{\cdot}07 \times 5{\cdot}10 \times 91 \times 5{\cdot}5 \times 300 \times {\cdot}603}{5{\cdot}75 \times 12 \times 2{\cdot}603} = 10440,$$

which shows that the chance of the spoke slipping round the nave during the ordinary working of the flywheel is very remote. Perhaps the greatest probability of the spokes slipping will be in the case of a bicycle driving wheel, but here again the practical experience of the last eighteen months shows that this possibility may be left out of consideration

Bending Stresses on the Rim.—There will be a bending moment on each radial section of the rim. Considering the portion of rim between two adjacent spokes, neglecting the curvature, the distribution of bending moment is the same as in a beam loaded uniformly and fixed at the supports, so that the elastic line at the supports is horizontal.

Let b = width of rim, h = thickness of rim measured radially, and l the length of rim between the two adjacent spokes, all expressed in inches. Let P be the total pull on each spoke in tons, which will also be the load distributed on the rim between two adjacent spokes. If this portion of the rim were free at the ends, the bending moment on the section midway between the spokes would be $\frac{Pl}{8}$ inch-tons ; but the ends being fixed, the bending moment on this section is $\frac{Pl}{24}$, while the bending moment on the sections at the spokes is $-\frac{Pl}{12}$ (See Cotterill's "Applied Mechanics." The maximum and minimum stresses due to the latter bending moment will each be $\pm\frac{Pl}{2b\,d^2}$.

In the example worked out above the spokes are $1\frac{1}{16}$ in. diameter and are subjected to a tensile stress of 3 tons per square inch at the rim. P is therefore $= 2{\cdot}66$ tons ; l is $= 9$ in., $b = 9$ in , and $d = 3$ in. The greatest tensile stress due to bending is therefore

$$\frac{2{\cdot}66 \times 9}{2 \times 9 + 9} = {\cdot}148 \text{ tons per square inch, showing that the stresses}$$

in the rim due to bending are practically negligible.

In closing this paper I must apologize for its being unnecessarily long and so much repetition, but my object was to make this treatise on the subject as complete as possible, and above all to emphasize the necessity for, as well as the many advantages to be derived from, the adoption of improved flywheel construction.

The city council of Montreal are said to be considering the installation of an electric light plant alongside the new garbage incinerator, with the object of using the surplus steam from the incinerator to operate the plant. It is believed that in this way sufficient power can be had to light St. Gabriel ward and Point St. Charles, and thereby effect a saving of $5,000 per year.

THE ELECTRIC BRAKE IN PRACTICE.

By Elmer A. Sperry.

Examination of accounts of the electric street railway companies of our large cities reveals the fact that the item of damage, already very great, is one of growing importance. Investigation of the circumstances and detailed statements of numerous items taken at random from the damage account, points at once, and in no uncertain way, to the inefficiency of the present hand brake. In many instances, could the car or train have been stopped within a comparatively short distance, the accident and resultant damages would have been entirely averted. The first investigation led to others with the same result, and in consequence the writer is prepared to show that nearly 85 per cent. of the accidents directly occurring, are due to the inefficient operation of brakes. The growing frequency of accidents and the constantly increasing demands of the public for damages, are indications that have not been made to impress the mind of the engineer, or I am sure adequate means would have been forthcoming for the correction of so grave a fault inherent in all the present systems of power-operated street cars. Some of our municipal authorities are taking action with reference to the increasing frequency and severity of accidents, and although no thorough scientific investigation of the matter has been published, yet it is a startling fact that with the present hand brake no electric or other equipment to-day stands provided with anything in the line of an emergency brake.

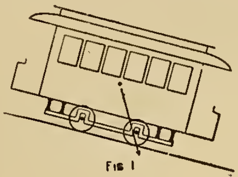


Fig 1

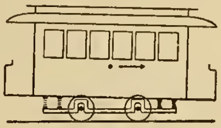


Fig 2

Enterprise in America for the public convenience of her citizens is truly phenomenal, and reaches its highest expression in conveniences for travel. The per capita investment in the cities and larger towns of this country for electric street railway work is much larger than is often realized; in some no less than $55 is invested for each man, woman and child for accommodation in intermural travel. The enormous aggregate sum thus invested has given a stimulus to engineers resulting in wonderful advancement and refinement in means for mobilizing the thousands of tons of human freight that are hourly seeking transport. Vast skill and almost untold resource have been devoted to perfecting means for overcoming inertia and quickly accelerating cars and trains which are ever increasing as to their weight and capacity, with patrons constantly more exacting as to speed and smoothness of operation, and especially as to safety. It is proverbial that while these advancements have been going forward, comparatively no attention has been paid to the mechanism for retarding and quickly but smoothly bringing the cars and trains to a stop.

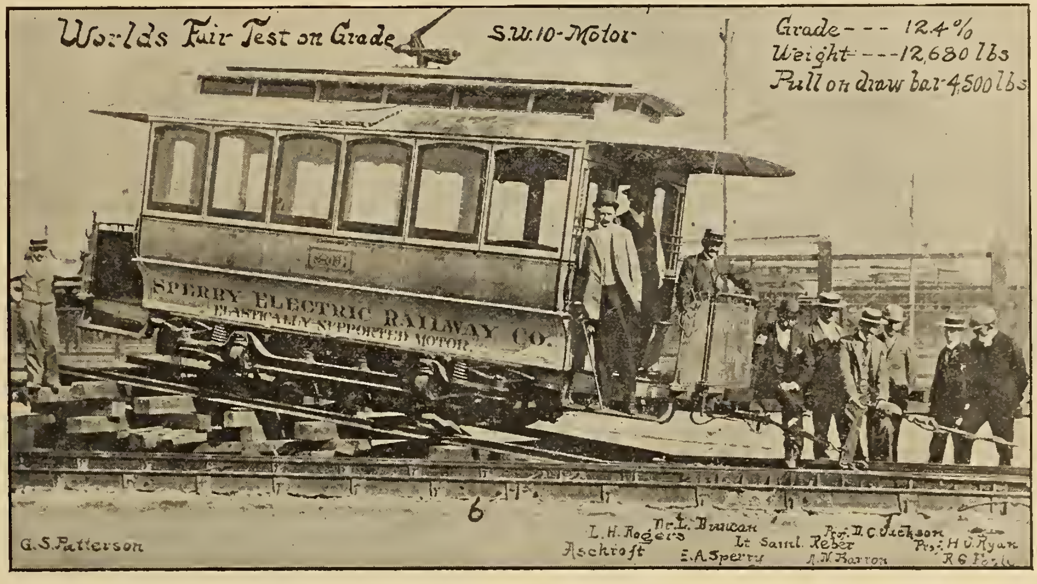


Fig. 3.

As the practice of the steam railroad engineer as to roadbed, speeds and weights is gradually approached, his experience in the solution of this most important problem of braking should be studied with care. In so doing, however, the features wherein the street car company is differentiated from the steam road problem should be kept prominently in mind. We must remember that the locomotive engineer is provided with a complete, expensive and somewhat intricate apparatus with which to de-energize his train. The periods of its application are comparatively infrequent, and as to personal capabilities, he is schooled and trained for years before ever being allowed to touch either the throttle or the air valve. While working, his pressure gauges allow him to adjust the brake application to a nicety. Moreover the time allowed for the total retardation and final stopping of his train is usually very long compared with that allowed in street railway practice.

Of the two, the street railway problem is the more exacting, and in the hands of far less experienced operators; and yet we are told that the mechanism involved in its solution must bear only a small ratio to the cost of the total equipment. Owing to the recently developed relation between effective braking and the accident and damage account, the purchaser will be spurred on to careful investigation as to the brake applied to his cars, and will be willing to spend sufficient time and money to effectually control the retarding as well as the accelerating car. To be sure, as little expense should be incurred here as possible, but enough to fully meet the requirements. Especially is this true now that ample power for applying the heaviest brakes is at hand, and even if used in a wasteful and extravagant manner, in the largest amount possible, is entirely without cost, and its means of control already at hand. The importance of this proposition should at once command the attention of all, and commend the problem as such to the engineer.

The popular appreciation of this point is illustrated by the growing frequency of its discussion by the daily press in our larger cities. The following is an extract from an editorial recently appearing:

"The number of deaths due to motor cars has alarmingly increased since the trolley system liberated the slow-going horse and mule. Not that the deaths are due to the electric current. The 'deadly trolley' notion has properly been exploded. It is the car wheels that are doing the deadly work. Now that motors and trucks have been in a measure standardized, managers of large roads, especially, are being asked by their patrons why they do not adopt proper precautions so that the death rate may be cut down. There is no one part of electric or cable railroading so important as the ability to stop the cars quickly. At such times hand-brakes show their inherent inadequacy."

In so grave and urgent a case what can be done in the line of remedy? The question naturally arises, will any system of braking worked upon in connection with the ordinary wheel of a vehicle by sufficient for the stop required? What is the maximum efficience obtainable by the brake working through the wheels? Is it sufficient to arrest the car before accident in case of emergency? Can it be made in any event a sufficient accident preventer? The popular notion that most accidents are due to brake failure is true, but in a way that is little understood, the failure being one of degree. It may not be known that under proper and standard conditions any car or train may be brought from a speed of ten miles an hour to absolute rest inside of ten feet. It is not generally appreciated that the wheel brake has ample capacity to accomplish this. The former investigations of the writer with reference to adhesion under conditions of acceleration and retardation, climbing and descending hills, afford ample proof that the rail adhesion through the wheels gives the wheel brake more than capacity sufficient to accomplish this result. For instance, assuming any weight and load, say 17,000 lbs., the stored up energy, 64,426 foot lbs., can with ease be dissipated within twenty feet for the ordinary equipment, and less than half of this distance, or a little over 9 feet, under conditions of coupled drivers, or if the wheels are compelled to revolve in unison. This latter consideration will be seen to have quite an unexpected as well as pertinent relation to the problem. It will be seen by a glance at the figures that the centre of gravity of the mass is far above the wheel contact with the rail. The retarding effect takes place on the base line in a plane below that of the centre of gravity, really the farthest projection downward of the mass as a whole. A sudden stop operating on this base line tends to pitch the upper portion forward bringing nearly all of the weight, and with it the retarding capacity, upon the front pair of wheels. The brakes on the rear pair in the ordinary equipment will have but little effect; if, however, by any practicable method they are coupled to the forward drivers, the brakes on this rear pair still remain active and of full effect. This is true even if the back pair should be lifted clear of the track. With increased weight upon the forward drivers comes ample increased adhesion, thus preserving the full tractive effort of the total weight intact for purposes of stop, which is impossible in the ordinary equipment. These effects are all aggravated in case of short wheel base. The present tendency toward a longer wheel base is a step decidedly in the right direction, and shoud be encouraged. The effect of shifting the load in reference to the axles will be especially noticed in descending hills, as shown in Fig. 1, where the momentum of the rapidly retarded mass tends to shift the load centre still further forward, in some cases almost wholly on to the front drivers. It will be seen to have less effect in *ascending* grades. Here in stopping, the inertia tends to correct the position of the shifted load, whereas going down, in stopping, the momentum, as stated, tends to still further aggravate the condition. The practical effect of this may be seen whenever an ordinary street car, mounted upon springs of fair resilience, is quickly stopped. The car will be seen to suddenly right itself, having been pitched forward in the process of stopping (see Fig. 2), the front springs being depressed and the rear springs extended. These considerations all go to show in a new light the advantages to be derived from coupled drivers for general street railway service.

In a paper presented at the last annual meeting of the National

Street Railway Association, the writer gave the results of an original investigation relating to the relative tractive value, expressed in draw-bar pull, of the two styles of street car equipment, viz., with separately driven axles and with coupled axles. A grade was built consisting of 45-lb. T rails rising from a spur of level track giving a mean grade of 12.4 per cent. Upon this grade was run first a double motor equipment weighing 17,935 lbs. A dynamo-meter was attached to the rear draw-bar and back to the track, in such a line as not to either lift the car or drag the rear end downward in the test. Current was then applied through a variable resistance, gradually allowing the car to strain upon the dynamo-meter until finally the wheels slipped. Care was especially exercised on the point of gradual application of the strain so as to eliminate all elements of inertia or lunging forward upon the dynamo-meter. It was found that a series-parallel controller is entirely useless for this purpose. After slipping of the wheels had commenced it was observed

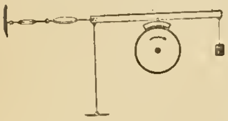


FIG 4

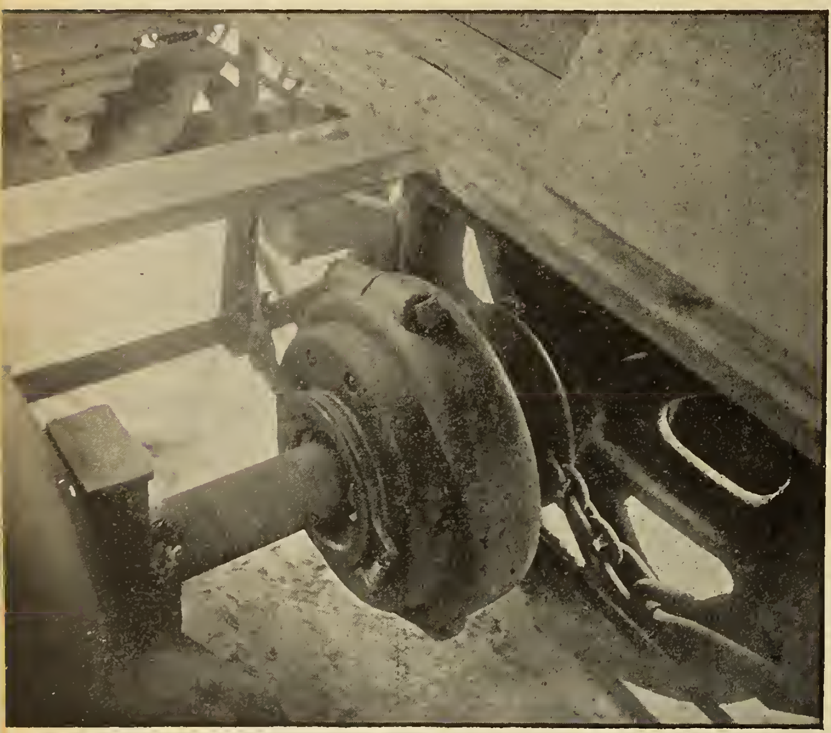


FIG. 5.

the same way and the same controlling rheostat and source of current was used as in the previous experiment, the axles in this equipment being coupled by bevel gears and to a single motor. The following table gives the means of five sets of readings taken from this car :

Coupled Axles, Single-Motor Equipment, Draw-bar Pull on Dynamo-meter Car standing upon

12.44 per cent. grade, weight of equipment, 12,685 lbs.

Group of tests.	Average amperes.	Average draw-bar pull.	Ratio draw bar pull to weight.
1	200	3125 lbs.	24 per cent.
2	240	3750 "	30 per cent.
3	230	4075 "	32 per cent.
4	220	4500 "	35 per cent.
5	200	4375 "	34.4 per eent.

The same operator applied current to the cars in all tests, and every condition of electrical pressure ; track and weather remained identical throughout. Other equipments of each class have since been tested, substantiating the above results. The accompanying cut, Fig. 3, shows a car standing on the grade with dynamo-meter attached.

Bearing these facts in mind, let us turn for an instant to the that the car would slide in each instance to the bottom of the grade. The values in the following table are each the mean of four sets of readings :

Independent Axle, Two-Motor Equipment, Draw-bar Pull on Dynamo-meter, Car Standing on

12.44 per cent. grade: weight of equipment 17,935 lbs.

Group of tests.	Average amperes.	Average draw-bar pull.	Ratio draw-bar pull to weight on drivers.
1	200	1625 lbs.	9 per cent.
2	280	2250 "	12.5 per cent.
3	240	2150 "	12 per cent.
4	230	2075 "	11 per cent

This car was run off the grade and replaced with one in which all the wheels are compelled to revolve in unison, but of much lighter weight, viz., 12,685 lbs. The dynamo-meter was attached in

ordinary hand brake. The ratio in the brake levers will be found in the modern trucks to be anywhere from 6 to $11\frac{1}{2}$, averaging about $8\frac{1}{2}$ to 1. The lever arm of the brake staff will be found to be anywhere from 6″ to 13″. Assuming 11″ as the average, the radius from the centre of the brake chain to the centre of the brake staff will be $1\frac{3}{4}$″, giving thus 6.28 to 1, or a total leverage of 53.4 to 1 from the operating handle to the brake beam. Two elements now have to be assumed : First, the friction co-efficient of the brake shoes acting upon chilled wheels ; Second, the power upon the brake staff. The writer has endeavored to cover both of these unknown quantities by actual experiment, giving the results in the tables. Table III. was taken by a dynamo-meter being fastened directly to the brake staff handle in line of the pull of the motorman, a cast iron brake wheel 16″ diameter from centre to centre of a $1\frac{1}{4}$″ rim bearing the handle. A number of experienced motormen were invited to test their strength upon this handle and careful readings were taken. It was noticed that the right arm of the more experienced motormen was much more developed than the left, a fact which, I think, has been pointed out before. The extent of this development in the forearm is certainly quite marked, showing that the gripping muscles and weight of the body are the elements brought most into play.

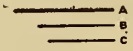


FIG. 7.

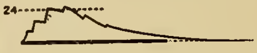


FIG. 6.

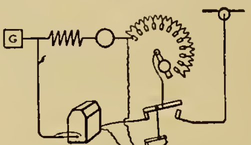


FIG 8

TABLE III.

No of Motorman	Weight of Motorman.	Gradual pull with one hand.	Jerk with both hands on hand-wheel.	Emergency, jerk with both hands on hand wheel.
6	140	112	135	275
58	200	135	275	385
264	287	145	235	312
62	175	125	212	285
123	153	125	245	310
60	185	150	200	300
26	170	150	275	350
96	155	135	210	325
246	135	110	175	325
287	135	125	250	350
66	160	125	250	405
4*	176	100	200	400
266	185	175	250	475
		Avg. 131.7	224	338.23

*9 years in service.

Right arm	Circumference of	forearm,	$12\frac{3}{4}$″
	"	biceps,	$14\frac{1}{4}$″
Left arm	"	forearm,	$11\frac{5}{8}$″
	"	biceps,	$13\frac{5}{8}$″

Columns 1 and 2 indicate respectively the No. of the motorman and his weight.

Column 3 indicates the greatest possible steady pull with the right hand on the handle, bringing into play all possible weight of the body.

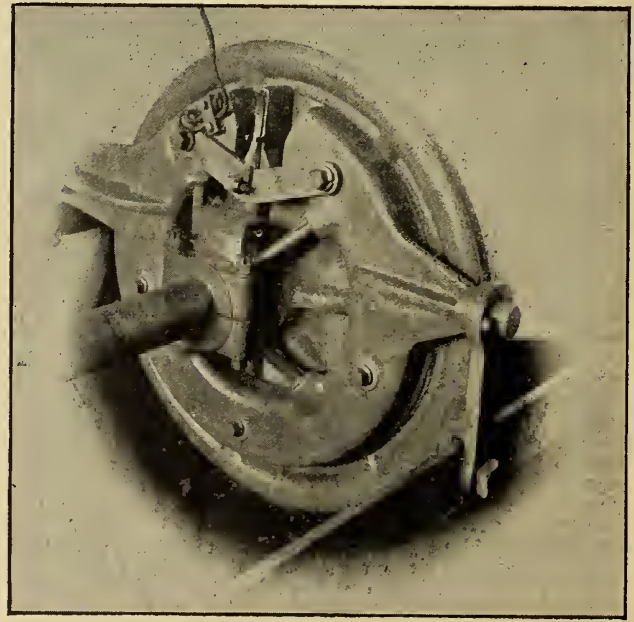


FIG. 9.

Column 4 indicates the same condition as Column 3, the motorman in this case grasping the hand wheel with both hands, some motormen using gloves to prevent their hands slipping. None of the men could maintain these values for more than $\frac{1}{2}$ second.

In Column 5 is indicated an "emergency stop." The motormen were told to "break the machine" if possible. In this test the body was braced, sometimes with the knee against the dasher rail, the needle registering the highest jerk usually given with a sudden lunge of the body.

It will be seen that the power applied by the steady pull of the average motorman is about 131.7, and can be made to run up in case both hands and the weight of the body are used to about 224 average, but this value cannot be maintained. The average values of column 5 cannot be used in these calculations, for the reason that although they show the pressures it is possible to reach jerking upon the hand wheel, these pressures cannot be maintained, and therefore cannot be depended upon for braking effect. The tests show that the full power that can be maintained upon the brake lever for a sufficient length of time for the purposes in hand does not exceed an average of 180 lbs.

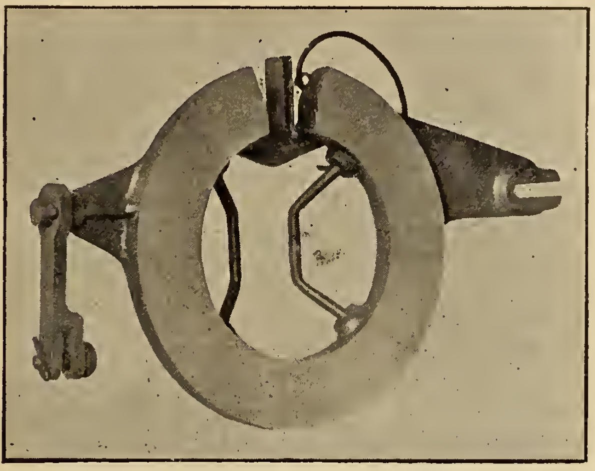


FIG. 10.

TABLE IV.

Speed, Revolutions per minute, 33" wheel.	Brake pressure.	Traction.	Coefficient.
Varying, 150	900 lbs.	87.4 lbs.	9.7 per cent.
125	"	91.7	10.2
100	"	99.8	11.1
78	"	118.	13.2
56	"	133.	14.8
38	"	150.4	16.6
20	"	154.	17.1
4	"	174.6	19.4
Constant, 105	300	29.4	9.8
	500	50.5	10.1
	750	91.	12.
100	1150	125.	11.2
	1500	178.	12.
	2200	305.	14.4
94	3780	488.	13.2

Table IV. was obtained as shown in Fig 4. A brake shoe that had been run in service about three or four days was taken with the axle carrying its co-operating wheel, lifted out of the truck and placed between the centres of a lathe, the load upon the brake shoe accurately measured, and the shoe held from movement around the wheel by a dynamo-meter. Every precaution was taken to avoid handling the periphery of the wheel or the face of the brake shoe, and even the dust was left upon it so as to conform as nearly as possible to the normal conditions of practice. Tracing our 180 lbs. application to the brake beam with allowance for loss by friction, we have 3840 lbs. applied to each of the two shoes, which upon the chilled surfaces are found under ordinary circumstances by Table IV. to give a coefficient of about 12 per cent. This would give a retarding effect of 460 lbs., which is less than one-third that easily obtainable were the power needful for its application at hand. The coefficient under these conditions would have been about 37 per cent. to realize anything like the total value of the retarding effect of the wheel. This under conditions of chilled and glazed surface is entirely out of the question, showing at once the necessity of power in the application of brakes if anything like their full value and use is to be obtained. This is also amply borne out in practice, as those who have tested this point well know, that under ordinary applications it is next to impossible to slip the wheels of a motor car by the hand brake.

In the electric brake, on the other hand, the fact that the truck parts are not bound up and locked into a solid mass by the enormous pressures of the heavy break levers and shoes, is found to prevent racking and straining the truck as well as jumping the track and curves when the breakes are set. The axles and truck parts are perfectly free for easy and normal movement even when the brake is exerting its full power. Great reduction of wear at the pedestal journals is also found, owing to entire absence of all of the usual heavy pressures of the brake shoes. We can all see that by applying adequate power and control to the wheel brake, this element of the equipment may be raised to the position of an indispensable safeguard, the value of which can only be appreciated as its hitherto undeveloped resources are brought out, demonstrated and rendered simple and easy of application and control. In practice the greatest necessity for maximum brake application exists at the higher speeds. From Table IV. it will be noticed that just at this point the failure is greatest, the coefficient being least, increasing as the speed decreases. This has always constituted the one grave fault of the air brake in railway service. The intensity of its application should be greatest when the speed is greatest, and decrease as the speed drops off. As will be shown further on, this point has been fully covered in the electric brake, which is the first time that the varying application has ever been embodied in practice, and especially in such a manner as to perform its important function automatically.

A plan, especially one pertaining to electrical matters, after having been proven mathematically to be feasible, is far from being realized. Many are the practical difficulties to be surmounted before a thorough commercial or anything like a standard apparatus has been produced. Especially is this true in the electrical field. Many subtle influences and energies are at work which well nigh overwhelm the experimenter. In a new field but few precedents are at hand, and these are apt to be extremely unreliable and in the nature of a blind leader of the blind. The practical application of the electric brake, although probably no exception to the general rule, amply illustrates the wide distance to be spanned between the conception of the idea and the commercial apparatus itself. For years the writer has believed that electricity was vastly preferable to any other force for the application and control of brakes. Working first on the solution of the continuous brake problem for railway trains, he built his first electric brake apparatus in '82, and has studied and experimented on the problem in its various phases almost continuously since that date, with more or less encouragement in line of substantial progress. As to its application to electric cars, the apparatus was successfully applied on some double-truck cars in Illinois, one of these cars weighing as much as 12 tons. The first of this apparatus, similar to that shown in Fig. 5, was constructed some five years since. This apparatus has been constantly undergoing alterations and been experimented with, until for the past eighteen months a constantly increasing number of electric cars, equipped with the electric brake apparatus, have been in regular service, some of these cars running with change of motormen on each of 13 daily trips, the same motorman having the car once in about three days, making it impossible for the men to become familiar with the operation of the brake. During this time one car has made upwards of 70,000 miles, hauling a trailer about 48,000 miles, during some special weeks of tests making from 178 to 220 miles daily. It is only under such rigorous conditions of actual operation that rapid progress can be made in reduction to practice. All machinery and apparatus must pass this ordeal successfully before it can be brought into thorough commercial shape.

At the mention of electric brakes, the engineer at once admits that they should be entirely feasible, and usually adds that there is plenty of electrical energy at hand from the central station to retard and control as well as propel the car. This, however, is not the method undertaken by the writer. To employ the central station current for operating the brakes would be to limit very materially their usefulness and certainty of operation. The braking current, although used at comparatively infrequent intervals, and then only for a short period, should, for this reason, be absolutely certain and unfailing in its action, and not subject to any "heart failure" of the central station, or sudden cessation caused by the opening of the circuit breakers, the interruption of the line, the flying off of the trolley, failure of the fuse, or failure at other more or less vulnerable points. The electric brake under discussion has been operated over a year on equipment upon different roads from electricity generated *per se*, being entirely independent of the trolley connection, the braking current not being derived from the central station, but produced by the power of the moving car, which power it is desired to get rid of or destroy. The brake thus operates equally well with the trolley off, and, as will be understood from the following description, the trolley current has nothing at all to do with the car while the brake is being operated, except possibly to maintain the light circuit. The electric brake at the same time is entirely independent of the hand brakes, which may or may not be present upon the equipment. The braking action being altogether independent of the ordinary brake shoes, it is not found necessary to employ them in connection with the electric brake, although in the earlier forms they were used, and in the case of trail cars, especially in heavy service and on grades, some engineers prefer to use them at the present time in connection

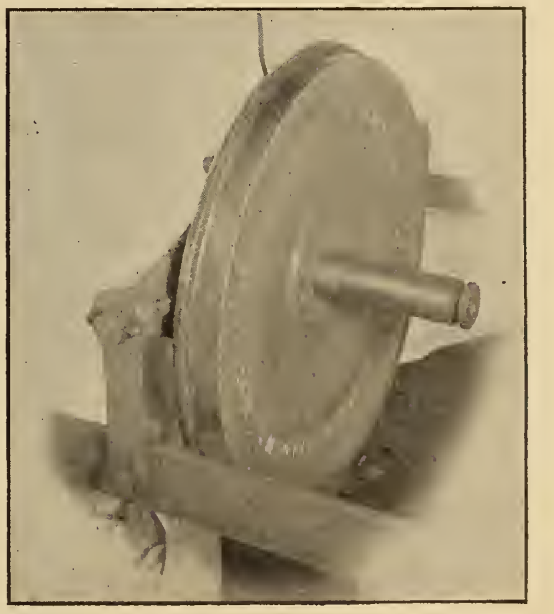


FIG. 11.

with apparatus such as shown in Fig. 5. The current employed by the writer for operating the brakes is developed by automatically turning the motor or motors into generators. As these are driven forward by the moving car they develop current which is controlled as to intensity by the starting rheostat of the car. The braking current is thus produced at the expense of the mechanical energy stored up in the moving car, which, being consumed, causes a retardation and final stopping of the mass as a whole. The current so generated may be farthermore led through a brake magnet as above seen, to apply the brake shoes; it may arrest the motion of the car direct by magnetic adhesion or develop heavy retarding currents in the moving metallic mass by magneto-induction. When an active local circuit is used, the latter method is usually employed for reasons which will be made more apparent.

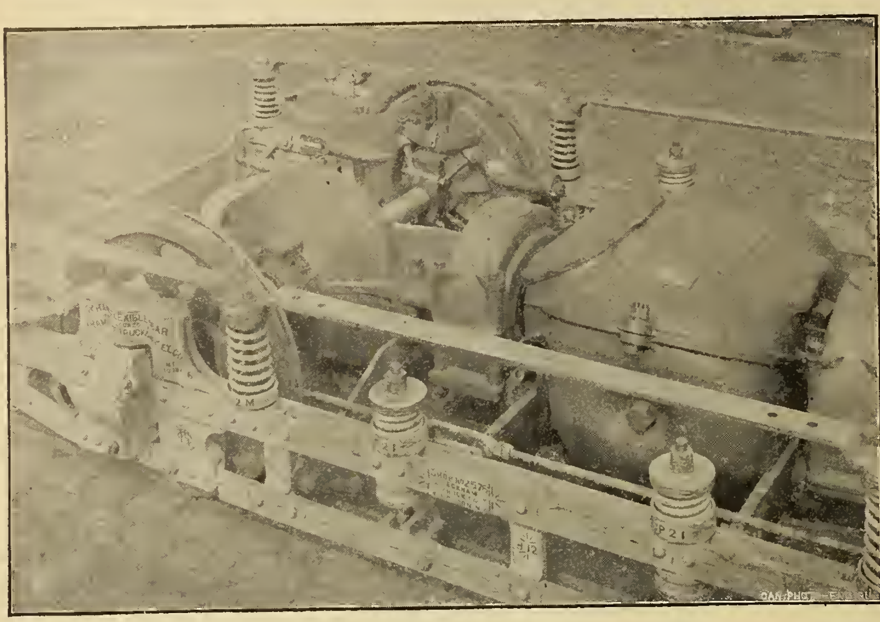


Fig. 12.

In developing this system the point which seemed fraught with the most difficulty, and which has finally received the simplest solution of any in connection with the problem, was that of obtaining always and with absolute certainty sufficient current at the lowest speeds without the aid of the trolley current. Teaser coils were at intervals resorted to, maintaining connection with the trolley circuit. "Artificial teasers" were also used, being a device by means of which the trolley circuit was entirely done away with, and which worked well. Observations made from time to time in connection with these experiments led to an exhaustive investigation of residual magnetism, in consequence of which structural means were adopted to utilize to the full the residual magnetism of the motor. This supply is constantly being renewed with every energizing of the car. This method was found to be the simplest as well as the most effective. The connections, and in fact the whole arrangement of the electric brake upon the car, is extremely simple. This is shown by the fact that only one small wire extra needs to be run to the controller in addition to the ordinary wiring of the standard equipment without the electric brake. The certainty of operation is evinced by the fact that at the present writing over 150 of the equipments have been placed, which are making upwards of ten thousand miles daily in regular service.

Early in the experimentation a phenomenon was observed in reference to the persistence of the current even after the motor had stopped. This is due to the slow action of the decreasing magnetization, taken together with the reaction or self-induction effect of the fields and any brake coil or coils that may be in the circuit. The movement of the magnetic lines, which persists after, and in fact long after, the motion of the motor has ceased, generates potential. In many instances it is possible to draw an arc from the rupture of the brake circuit one second after the motion has ceased, showing the presence of current in the local circuit. Diagram Fig. 6 has been developed from the average stop to show the curve of current in reference to the motion, the black lines indicating the period of motion during the application of the brake, and the curve indicating the current intensity and its duration. The current flowing after motion ceases, though small, is found exceedingly useful in holding the car from starting to move, even on quite a heavy grade, as only a small quantity of energy added to the already great friction of quiescence will prevent the car from starting. This persistency of current is also found useful to kill or destroy the magnetism of the brake magnet, in case it is desired to suddenly move the car forward again. The tendency on the part of the windings at the moment of rupture to generate an opposing electro-motive force tends to suddenly free the magnet from its face, a purely accidental feature, which is of great value and utility in this connection. The wonderful energy of the withdrawal of the lines of force, being in its manifestation a phenomenon of magnetic viscosity, is illustrated by the following fact: With a perfectly dry track a great force is required to shear the adhesion and start the wheels slipping. A car going down a grade under these conditions where no brake magnets are present, will, with a sudden application of the electric brake, generate sufficient current to not only arrest the motion of the wheels, but start them going in the opposite direction, the reverse motion being maintained through an interval truly remarkable, in some instances running as high as 1⅓ seconds. It will be borne in mind that all the above phenomena are entirely independent of the central station current, the trolley connection having been severed before the brake is applied.

The current required to be developed to stop a car when no other breaking apparatus is used, is found to be only a fraction of that required to accelerate the car in the same interval. This may be easily illustrated by the lines in diagram figure 7, A being the electrical energy applied in a given acceleration; B the resulting mechanical energy stored in the car after deducting all wastes in the motor and between the motor and the momentum; C the average mechanical energy in the car at the time of applying the brake; D being the electrical energy required to be developed for retardation after the efficiency losses have all been provided for out of the quantity C. Thus it will be seen that the so-called efficiency losses act in a two-fold sense, between A and B and between C and D, to reduce the amount of current required to be generated for braking purposes.

As to the effect of the electric brake on the total temperature of the motor, the following experiments were made. A car and trailer were operated over the line in regular service 41.1 miles without the brake. The temperature of the atmosphere was noted every half hour during the test, and the temperature carefully taken of all parts of the motor at the end of the run. The succeeding day a similar run was made with the same trailer over the same track and in the same length of time, but with the electric brake in use, braking direct on the simple local circuit without brake magnets. The difference in the average atmospheric temperatures during the two days was 6½ degrees, and the difference in the average temperature of the motor parts was 7 degrees, making only a difference of one-half of one degree Centigrade as the total increase of temperature from the use of the brake. Observations in reference to the heat in the rheostat were made, although no temperatures were taken, and no difference could be observed in reference to the heating of this portion of the equipment. The explanation will be found in the comparatively small amount of current as seen above, and the relative infrequency of its application and short duration at the time of each application. The following wattmeter readings have also been taken:

	1st trip.	2nd trip, trailer.
Reading of wattmeter, leaving Lake View	392,538.9	392,542.25
Reading of wattmeter, end of round trip	392,542.25	392,547.1
Number of full stops	55	53
Number of slow-ups	42	37
Time	1:40	1:35
Difference in reading	3.35	4.85

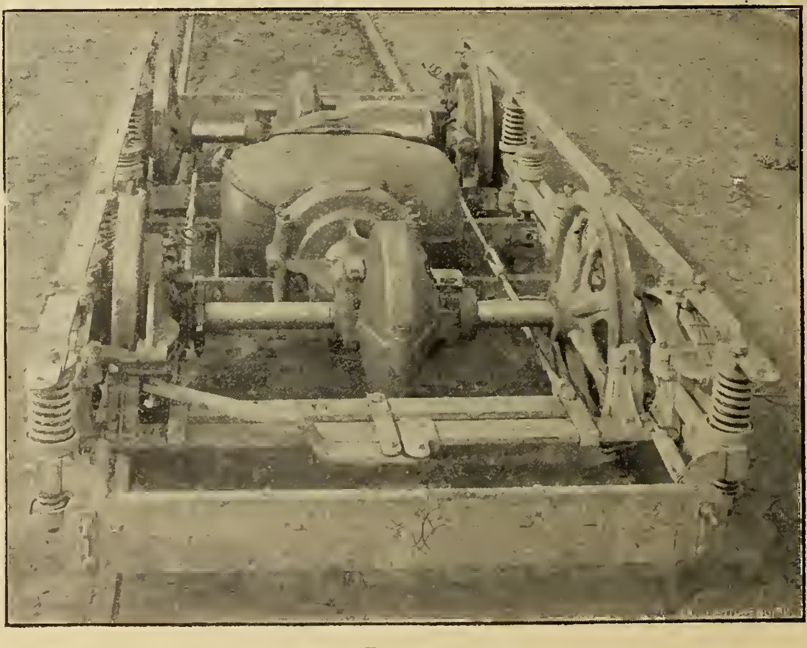


Fig. 13.

Constant of wattmeter equals "22", total watts both trips, 180.4

Diagram No. 8 indicates the connection of the wattmeter in the circuit.

Automatic resistances were even at one time used in the endeavor to relieve the motorman of *all* responsibility in connection with the control in applying the brake, but superlative simplicity was found to be much more desirable than the superlatively automatic, and the automatic devices were seen to be entirely unnecessary, the apparatus as at present constructed being of great simplicity.

The diagram of the braking current in Fig. 6 shows the automatic decrease in the intensity of the brake application so desirable with the decreasing speed referred to above. As the speed decreases the generator runs more slowly and consequently produces less and less current.

With this style of brake the life of the wheels is increased from two to three-fold, thus affording a saving in the item next in cost to the electric maintenance itself, to say nothing of the entire saving in brake shoes. This is emphasized by the fact that the brake shoes are being constantly besmeared with sand and grit thrown from the wheels, and when in this condition, they are brought against the wheels with the tremendous pressures noted above. A better method could hardly be devised for reducing both wheel and shoe. We little realize the great number of brake applications necessary in a day's run. Careful record has been kept of this point, giving in three days an average of 1377 brake applications for a run of about 164 miles.

Another interesting feature in this connection is that a flat wheel from skidding is an impossibility. It will readily be seen that should the wheels stop, the generator connected with the axles ceases to produce current, and none therefore exists to farther apply the brake, and though they may be sliding forward on the rail, yet the wheels continue to rotate more or less and constantly present new surfaces for the sliding contact.

The braking action is two-fold and is especially efficient. The rotating armature of the motor, instead of tugging ahead by its momentum, is itself pulling back and more or less powerfully braking the car through the gears by the retarding effort of the magnetism of its field while generating the braking current. The power required therefore to perform this work is taken from energy of the moving car which it is desired to destroy; not only is the car thus retarded, but the electric brakes arrest the motion of the wheels direct with a force that is remarkably powerful and under perfect control of the motorman.

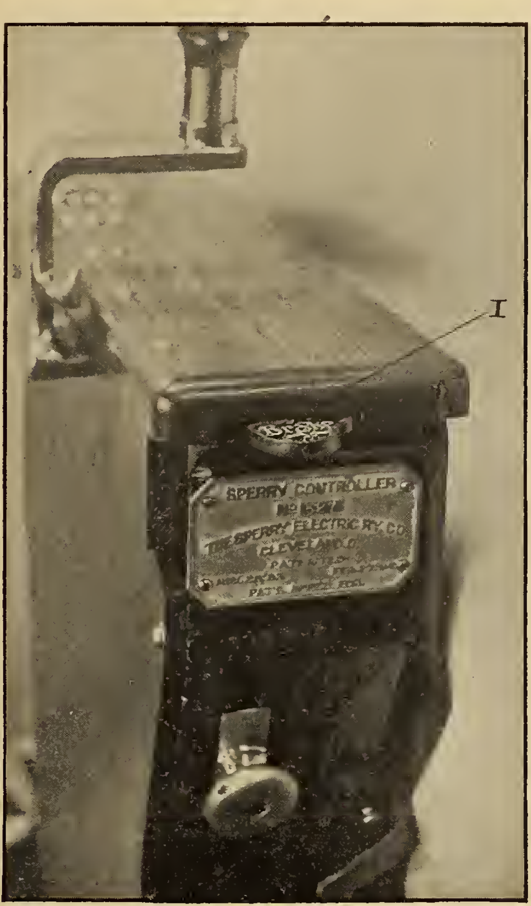


FIG. 14.

Two forms of braking magnets are used, one for winding up a brake chain usually employed in connection with the trailer, shown in Fig. 5, and another for directly arresting the motion of the axles, one magnet only being used in connection with each axle, as shown in Figs. 9, 10 and 11. These magnets are truck mounted, not an ounce of their weight being directly on the axle, and are so supported that their gravity acts to automatically retract them away from the braking face, see Figs. 11 and 12, the latter showing the link standing out of the vertical. The brake face is automatically lubricated to a slight degree, receives a high polish, and does not cut or rapidly wear. The brake is noiseless in its operation. It will be seen from the cuts that inasmuch as it does not revolve no commutating or contact device is necessary. Its crescent form accomplishes important technical functions and also eliminates the necessity of pulling off a wheel for its attachment, removal or inspection. The brake is shown in position on truck in Fig. 13. Its face is *solid unbroken metal,* with no grooves or interstices for catching grit or sand, which in part explains the absence of wear above referred to. The brake magnet is practically indestructible, a few turns of stout wire constituting its one coil entirely enclosed and sealed in metal. No harm nor moisture can reach it. As to moisture, it is immaterial, as the electromotive force at which it works is extremely small, seldom reaching six volts. The lubricator for the brake is dry, not sticky or adhesive, and does not gather sand or dirt and retain it upon the braking face. No mechanical pressures whatever are employed to arrest the car, and hence no strain or shoulder wear comes upon the journals. In constructing the brake magnets their proportions and the arrangement of the magnetic circuits received considerable study. It was during some preliminary experiments that an unexpected phenomenon was noticed, namely, that the retarding effect when speed is an element, is very much more than would have been expected from the coefficient of friction due to magnetic attraction or adhesion, this latter being a known and definite quantity. Farther experiment, made to ascertain the cause, showed it to be due to Foucault or Eddy currents set up in the masses. The conditions and structure of the brake magnet were therefore varied in a number of particulars, especially such as would be expected to give the greatest result in Foucault currents produced. The result was immediately successful. It was found that the retarding effect of the brake magnet is due very much more to the generation of these currents than to the direct effect of the coefficient of friction resulting from direct magnetic adhesion, the amount of which I find can be relied upon accurately when employed by itself. Some of the forms of brake magnets experimented with were provided with numerous poles of opposite polarity which were worked upon three different kinds of armature, two of which had radial teeth of different number relative to those in the magnet, and one being a plain disk armature. The toothed armature, while it causes a series of sudden jerks and is also unsatisfactory in the total retardation

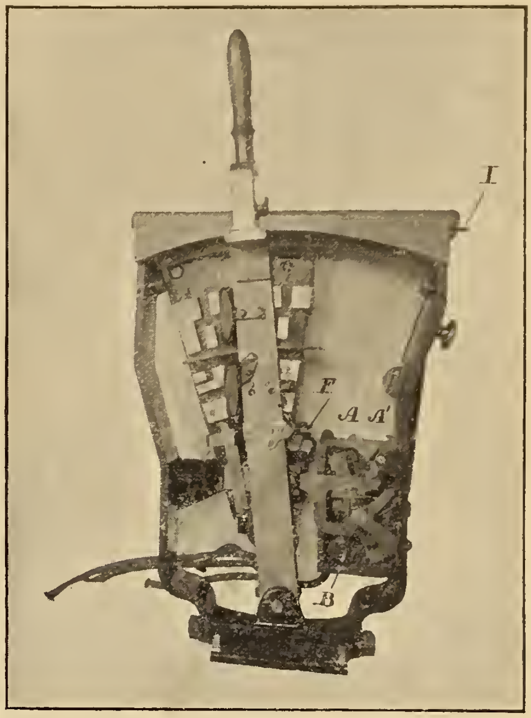


FIG. 15.

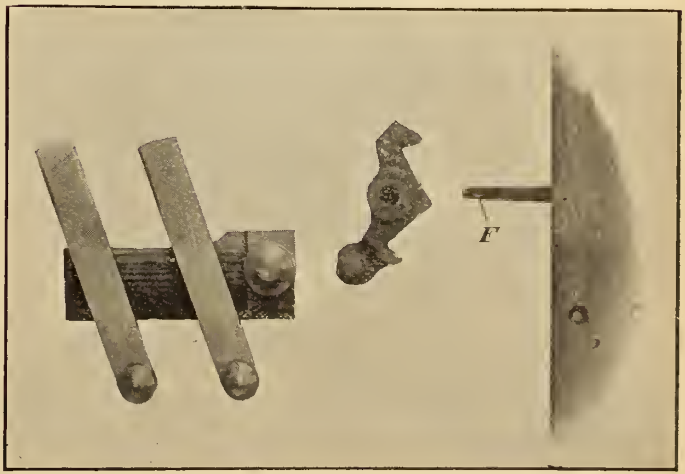


FIG 16.

resulting from a given input, is found also upon rupture of the magnetic circuit to impart to the magnet coil certain counter electromotive-forces which materially cut down the current supply and thus the capacity of the device. A magnet formed of a continuous disk with an annular groove sunk in its face, is found to give very satisfactory results, but is much heavier and requires an armature twice as heavy for a given number of lines than the double circuit magnet shown in the figures. Furthermore, the relative rotation between such a magnet and its armature affords no point in the masses where the lines are interrupted or changed, and the Foucault currents, or reactionary effect set up, is very much inferior to those in a magnet where a gap or cessation of magnetic stress is easily produced. As a result of these investigations the crescent form shown in the figures has been adopted, the opening in the crescent, giving the effect referred to, as well as affording an excellent method of attachment and removal of the brake magnet, and at the same time supplying a gap for easily reaching the face for inspection and lubrication. A lubricator, see Figs. 9 and 10, is shown as occupying this space. The belief that the extra retarding phenomenon is that of Foucault or other eddy currents, is borne out by the fact that a conducting lubricant, such as graphite, is found to considerably increase the effect, also metal filling between the polar faces is almost indispensable for the best results, while at the same time effectually protecting the coil from all damage. These observations would seem to indicate that the eddy currents, however produced, circulate in both masses near the surface and traverse back and forth across the air gap whenever ample provision is made to allow them so to do. The practical value of the combined action of all these forces in increasing the retarding effect results in necessitating but a small magnet and a smaller current expenditure considering the work performed.

TABLE V.

Amperes.	Volts.	"A." Pull due to magnetic adhesion or traction friction coefficient 10%.	"B." Pull on brake chain obtained Graphite lubrication.
5	1	7.6 lbs.	125 lbs.
9	1.8	18.3	300
9.5	1.9	36.4	608
15	3	121	1976
16	3.2	149	2432
20	4	158.4	2584
23	4.6	167	2736
25	5	186	3040
31	6.2	207	3385
35	7	213	3490
35.5	7.3	214	3500
41	8.5	223	3650

The assumed values are based on a traction of 28.26 lbs. per square inch for 45,000 lines per square inch, being the assumed values at the knee of the curve easily recognized as occurring between 16 and 20 amperes in the table.

By reference to Table V. the result in retardation gained through the eddy or other currents may be plainly seen, column "A" indicating the retarding effect which should be expected from a friction coefficient of 10% between the lubricated surfaces due to magnetic traction of the lines actually circulating; and column "B" indicating the values of retardation actually obtained on the dynamometer.

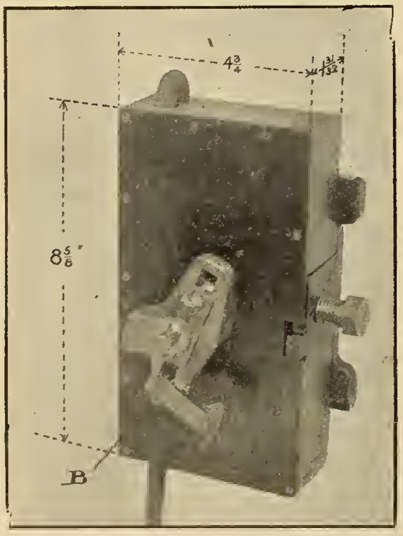


FIG. 17.

That the important position and trying circumstances under which the motorman often labors are appreciated, may be seen by the space devoted to it in the daily press. An editorial in an evening paper reads thus:

"One trembles to think what consequences may follow if a motorman gets rattled or has a fainting fit when trying to wind up his hand brake in time. Muscles grow weary and relax at a critical time. Even when a man is in fine working condition, the strain upon him is severe when compelled to handle the grip lever or current controller and hand brake simultaneously."

As to the arrangement for application and control of the brake by the motorman, about a year ago the following appeared from the hand of the writer:

"Considering the inexperience of the operator and the responsibility which at times well nigh overwhelms him, I think that, as engineers, we should be willing to set a very high mark to be attained in the ideal brake for electric street railway service, namely, the use of but a *single controlling handle for everything*; starting, accelerating, retarding and braking, the trailer or trailers and all. Let the motorman have nothing to think of except one handle, and two-thirds of the accidents now occurring will be prevented. Let this handle require no more exertion in its operation than the present controlling handle. Let the motorman fulfil his function with as little physical exertion as possible; he will then have a greater reserve for mental application when necessary. A motorman required to exert an enormous amount of brute force, constantly grinding at the brake, has but little left to apply in case of emergency. I agree with a prominent writer on this subject, where he says that a multiplicity of handles is fatal in time of emergency."

At the time the above was written, equipments controlled as therein set forth, namely, by the use of a *single controlling handle for everything*, had been in operation for upwards of a year. The methods employed for accomplishing this have been varied, but the form most in use at the present time is that shown in Fig. 14, where the resistance contacts are employed in a two-fold manner; the controller handle is made to operate back and forth over the same contacts for controlling both the application of the current to the motor and braking the car. A self-correcting and interlocking device is also provided, shown at "A A," Fig. 15, so if the motorman does not throw the handle clear over, the transformation is completed automatically before the movement of the lever can reach the operating contacts.

At one point, where a number of equipments were started last summer, a newspaper correspondent described the operation of the brake as follows:

"The connecting beam was taken from the trolley wire several times, and the car brought to a sudden stop with the electric brake alone, within three-quarters of a car length. And it was not a sharp, jerky stop, but something as if the car had run into a big feather tick."

The smoothness of even a sudden stop by the electric brake is quite aptly described by this droll statement. It seems as though the car was running into an air cushion.

It will thus be seen that the brake is automatic and does its work without any special act or even the knowledge of the motorman. He simply "works a single handle" back and forth, and electricity "does the rest." Suppose the motorman wishes to stop his car, he turns off the current by simply swinging the lever over to the right. This operation is made to automatically convert the motor into a special dynamo for generating currents at very low speeds, and also simultaneously to cut off all connection with the trolley current. The brakes are then applied by simply swinging the handle back over the path it has just traversed; the farther it is swung to the left the stronger the brakes are applied. The act of releasing or letting off the brakes again automatically re-establishes connection with the trolley and re-converts the dynamo into a motor. Fig. 16 shows the switches used in part for the conversion of the motor, and also the finger "F" mounted upon the lever forming a part of the alternate stroke operating device. The trolley brake-switch "B" is shown open in Fig. 15, and closed, with dimensions, in Fig. 17. The same rheostat and contacts are employed to control the motor while running the car and also to control the slight amount of current generated by the transformed dynamo which is sufficient to brake the train.

The motorman cannot turn on the current before the brakes have been released, nor can he apply the brakes before the current has been turned off. This is a result of construction, and constitutes a feature of merit in the new electric brake, effecting an economy in current and a saving in wear and tear. Freeing the conductor of all care in this connection, and leaving the running and especially the braking of the train, including trailer or trailers and all, solely in the hands of the motorman—by placing at his command a power with which he may with the utmost ease accomplish his task—constitutes an important advance in the art of control of electric railway equipment.

It has been found that the electric brake is practically incapable of abuse by the motorman—an advantage which never before has been attained in any power brake—from the fact above named, that no amount of over-application can cause flattening of the wheels or any harm whatever to any part of the equipment through locking and skidding of the wheels.

The application of the brake, its regulation and also the running of the car, all by a single operating handle, is a result that has only been accomplished by the severest application. It has involved much pioneer work and been rendered possible through the use of new mechanical movements original with the writer. The principal moving parts are simple and durable, being only two in number. The arrangement may be easily seen in the controller and parts exhibited, as well as in Figs. 15, 16 and 17. The various portions of the controller have been subjected to the severest tests possible, one test made in 1893 consisting in 518,700 consecutive brake applications without appreciable wear, the parts being in regular service at the present time. An indicator at the right side of the controller at the top (see I, Figs. 14 and 15) shows when the controller is in condition for brake or is being so used.

Operating the brake in this manner, it will at once be seen that the system is one of the utmost certainty of operation, surer even than the hand brake, air or other power brake, from the fact that every time the car runs, the motor, which is depended on for the braking action, receives a test, and its fitness and capacity for the next brake application is constantly being demonstrated. On the other hand, the motorman never knows whether his hand brake is sure to operate when called upon for the next application. An accident came under the observation of the writer on Case avenue hill in Cleveland. Here the last hand brake application was successful in every way, but before the brake was called into action again a nut dropped off from a brake rod upon the truck, rendering the brake useless. The motorman continued to wind on his brake staff, and before he realized what the trouble was, his car was going at a tremendous speed into a short curve at the foot of the hill. There were a number of casualties and also six demands for damages as a result. With the air or other power brake this liability to failure is increased in direct proportion to the complexity and number of parts.

The advantages found to result from the practical use of the electric brake, as compared with former brake systems, its qualities as an accident preventer, as well as its general commercial value, may be recapitulated as follows:

1. The certainty of its operation.
2. The enormous power at instant command and under perfect control.
3. The absence of all power absorption at moneyed cost from the central station.
4. Its high efficiency, being far superior to compressed air; amply proven in numberless instances where electricity has replaced air. (The air requires a direct application of energy, amounting to an immense aggregate power-absorption during the day from the central station; the working parts of the air machinery are attached to the car axles and require a large quantity of energy, not only while compressing but at other times as well.)
5. Its extreme simplicity.
6. Observed saving in wheels two to three-fold.
7. Entire saving in brake shoes.
8. Lubrication of brake face, practically no wear—either wheel or magnet.
9. Absolute silence of operation and release. (No hissing to frighten horses on streets.)
10. The low electro-motive force at which it operates.
11. The ease of its application and control.
12. Conserving strength and prolonging the usefulness and life of the motormen.
13. The smoothness of its operation.
14. Cannot cause flat wheels.

MUNICIPAL ELECTRIC LIGHTING.

By E. Carl Breithaupt.

The question of how industries that are to a greater or lesser degree carried on for the accommodation and benefit of the general public, can be conducted to the best advantage, has always been one of national economic import, and the idea that they should be owned and operated by the public body corporate is not altogether a new one.

The principle is enunciated by economists that industries of this nature, such as transportation, the transmission of intelligence, the supply of water, and of artificial light, are monopolies inherently and essentially; they are therefore classed as natural monopolies. All of these industries are primarily under the control of the State, and for this reason, it is claimed, they should be owned and operated by the Government.

The advantages claimed for such ownership are that the work would be more economically performed, the margin of profit which a private company derives from the business being saved to the public treasury, and that the service rendered would be a more efficient one. Moreover, it is held, that private ownership of these industries encourages corruption, particularly among legislative bodies, and that under government ownership this would be done away with. To the public mind the word monopoly conveys the idea of an autocratic power which leads to abuse of privileges and advantages enjoyed, and consequent abnormal returns on capital invested. Prof. Richard T. Ely, of the University of Wisconsin, holds that private monopoly is a menace to the public, and that men are not good enough to be entrusted with such a despotism as that which monopoly confers.

It is the purpose of this paper to consider the question of government ownership of natural monopolies only in so far as it concerns works for the supply of artificial light, and particularly such as is wholly for the public use, viz., the lighting of streets and public buildings.

It is proposed that these works be owned and operated by the Municipal Corporation, and many cities and towns have been considering the advisability of the plan. The question has been hotly argued on both sides, and it is to be regretted that these discussions are not always conducted in a fair-minded, liberal manner. Arguments advanced by men interested in private lighting companies are denounced by their opponents as prejudiced opinions; the cry of "Monopolist" is raised to enlist public favor on the side of municipal ownership, and the same offence is thus committed as is charged. It is but natural that persons having capital invested in any particular enterprise should strive to protect their investments, especially in a case of so serious a nature where the threatened danger means inevitable destruction. On the other hand there is much to show that the arguments put forth by the advocates of municipal ownership are not always inspired by pure and unselfish motives. If these discussions are to accomplish any good the opinions advanced by either side must be honest and unbiassed, and above all the facts and figures cited must be truthful, for the outcome of the case really hinges thereon.

The burden of proof lies with the advocates of municipal ownership, and the arguments in favor of their claim are identical with those of the complete scheme of government ownership.

Can a Municipal Corporation perform its own lighting service cheaper than a private company can supply it? Figures are given showing the cost of the service where the plant is owned and operated by the municipality, and estimates are made on the cost of building and operating proposed plants, nearly all of which are so surprisingly low that they must at once arouse suspicion in the minds of thoughtful men. According to these reports the cost of public lighting, where it is done by the municipality, averages about one-half of the price usually paid to private companies. One town in Illinois having 120 electric lamps on its streets, even reports that these cost nothing, that the expenses of operating are all paid by the profit received from commercial lighting. It is a significant fact, however, that these figures rarely represent the actual total cost. There is a tendency on the part of the advocates of municipal ownership to underestimate or entirely ignore any items which are not cash actually paid out, such as depreciation in value of plant due to wear and tear, and to the fact that new and improved apparatus and methods are constantly coming into use. interest on acpital invested, insurance, taxes, and in some cases water supply. The town treasurer's statement of expenditures incurred in operation is often the only outlay considered, and even this may be incomplete since municipal authorities do not always analyze accounts so as to show a full statement for each department. Insurance and similar expenses may be debited to separate ledger accounts and not appear at all in the statement of a particular department. Other items are charged to the department where they belong, but under the wrong heading. As a case in point, we may cite the financial statement of Toronto Junction for 1893. Under receipts and disbursements authorized by by-laws for issuing debentures on account of electric light construction, we we find an item for rebuilding engine bed of $162.93. This was a repair and properly belongs to maintenance.

Now, it is plainly unfair to compare such figures with those paid to private companies and say that a municipality operating its own plant saves the difference. To compare results intelligently we must agree on a basis of comparison. If the price paid a private company is remunerative to them, it includes depreciation, interest, insurance and taxes, and we must therefore debit a municipal plant therewith. The municipality may for a number of years persuade itself to believe that these expenses are imaginary, but it must meet them in the end, and no matter to which account they are charged they are incurred by the lighting plant.

Mr. M. J. Francisco, now president of the National Electric Light Association, last year published a large amount of data on the cost of street lighting, which is of interest in this connection. He gives figures from municipal plants scattered over nearly the whole territory of the United States, and computes the cost per lamp, adding interest depreciation, insurance and taxes; he states that the original reports signed by the city officials are on file and open to inspection by any person who may desire to test the accuracy of his figures. The most economical station cited is Marshalltown, Iowa, where 64 lamps of 1,200 nominal c.p. are lighted 300 nights each year until 12 o'clock, at a cost of $51.87 per lamp. The plant is run in connection with the water works and the cost of coal and labor is divided between the two departments. Of these 76 plants only ten show a cost of less than $80.00 per lamp per annum; five of them using 2,000 c.p. lamps until midnight; one, 2,000 c.p. lamps until 2 o'clock a.m., and four using 1,200 c.p. lamps. The average price paid is $116.46 per lamp per annum and 5 6-10 cents per lamp per hour. Compare these figures with Canadian contract prices. In statistics compiled by the Citizens' Telephone and Electric Light Company, Lt'd, of Rat Portage, Ont., and published last month, we find eleven towns and cities reported where a 2,000 c.p. arc light is furnished until midnight at prices ranging from $45.00 to $80.00, twelve towns and cities where a 2,000 c.p. light is furnished all night at prices ranging from $65.80 to $162.00, but only one of these, viz., Winnipeg, exceeds in price the average cost of $116.46, for municipal plants as above stated. In the town of Arnprior a 1,000 c.p. light is furnished until midnight for $54 75, the motive power being water and steam, while in Berlin the same light is furnished for $45.00.

In a report to the Committee on Works by City Engineer Keating, of Toronto, dated May, 1894, Mr. Keating includes a table which he compiled from reports directly received, showing cost per annum for street lamps where the lighting is done by the municipalities.

NAME OF CITY	LAMPS.		COST PER ANNUM.	
	Number	Candle Power	As given by Mr Keating.	As given by Mr. Francisco.
Savannah, Mo.....	25	1,200	$25 00	$150 00
Danville, Va.	90	1.200	44 00	53 90
Ashtabula, O.	70	2,000	90 00	117 85
Bay City, Mich. ..	181	2 000	49 00	92 65
Aurora, Ill.	119	2,000	68 00	117 33
Hannibal, Mo.....	120	2,000	65 00	118 37
Ypsilanti, Mich ..	88	2,000	34 67	97 73
West Troy, N.Y...	103	2,000	70 00	114 67
Easton, Pa.	113	2,000	77 95	147 22
Bloomington, Ill...	225	2,000	61 00	122 55
Lewiston, Me	100	2,000	43 00	87 50
Topeka, Kan.	184	2,000	93 00	129 00
Bangor, Me.......	156	2,000	45 00	91 30
Jamestown, N.Y. ..	140	1,200	50 00	69 24
Chicago, Ill.......	1112	2,000	96 64	194 89
Allegheny, Pa.	519	2,000	59 51 72 00 †	92 15

†Includes interest and depreciation.

Mr. Keating states there may be a difficulty in such cases in arriving at absolutely correct figures, and that an allowance should be made for interest and depreciation in order to arrive at a fair comparison. The figures he gives are so materially lower than those of Mr. Francisco that we can infer they do not include this allowance. I therefore reproduce them side by side in the above table to show the difference in results obtained by the two methods of computation, and the unreliability of municipal reports.

The other data given do not agree in all cases. Mr. Keating's table contains some evident errors: e.g., for Savannah, Mo., he gives the total operating expenses as $2,500.00, making a cost of $100 00, instead of $25.00 per lamp.

Again, Mr. Keating's estimate of running expenses is altogether too low, especially in the amount it includes for labor. The Secretary of the Fire Department estimates the annual cost per lamp for 1,300 lamps at $103.85, while the price at present paid for about 1,000 lamps is $108.58, leaving a difference of $4.73 per lamp in favor of the city. This is certainly a small margin to warrant an investment of $310,000, particularly as it is only an estimated margin.

The city of Philadelphia lately had under consideration the advisability of doing its own lighting. Chief Walker, of the Electrical Bureau, estimated the cost of 2,000 c.p. lights at 23 to 25 cents per night, but the Committee of Council after an investigation in which they took evidence from all available sources, figured the cost as about 43 cents and recommended the council to abandon the plan.

In Topeka, Kansas, the work of street lighting has been done by the corporation for some time and the plant has been under the superintendency of careful, competent men. The City Engineer has compiled very complete returns covering a period of 38 months, according to which the average cost per lamp per annum is $93, not including depreciation, taxes and water. It is admitted that the plant is not proving satisfactory and that the local companies would furnish the same light at a cost of 20% to 30% less.

The Town of Seaforth, which until lately supplied its own light, reported in 1892 that they were satisfied the light could not be run as satisfactorily or as economically by the corporation as by a private company, though it was operated in connection with the water works. Now they report that they have just sold out to a private firm.

The *Electrical Engineer*, an independent electrical journal, has just published the results of an investigation made under its auspices on the cost of municipal lighting. In commenting thereon the editor remarks that "in no respect do these figures justify the statements that have been made as to the superior economy of municipal plants."

Can a municipal corporation perform its lighting service more efficiently than a private company can? A successful manager of a central station for the supply of gas or electricity must possess no small amount of general engineering ability. He must have a technical knowledge of gas and electric matters as well as a thorough acquaintance with all the details of the plant under his charge. All this requires years of special training and experience. A municipal plant is managed by a committee of the council. When the size of the plant warrants it, a superintendent is appointed, otherwise the clerk or other town official, or the chairman of the committee has it in charge. In either case it is under the jurisdiction of the committee, a body of men who hold office for only one year, and who, while they are probably well versed in their own private business, usually have no knowledge of gas or electric light matters. Is it reasonable to suppose that a business will be better conducted so than under the management of men who devote their whole time and energy thereto.

Among the answers received by the writer in reply to enquiries regarding municipal plants, one states: "The greatest drawback to the town owning the plant has been too many bosses;" another quoted by the *Electrical Engineer* complains that everybody tries to run the plant and says: "The mayor and committee, with the assistance of a leather-headed clerk, all dictate what shall be done and where supplies shall be bought." Truly the lot of a municipal superintendent seems a hard one. The same writer says further, "with eight years experience, I would advise all towns to hire their light, which is by far the cheapest."

The question of economy and efficiency are interdependent. The managing committee of a municipal plant lacks the motive to effort, the incentive to economical operation and to close personal attention that a man finds in his own private business. Would you risk an investment in any industry under the management of a committee of a municipal council? If not, then why risk under such management an investment of funds which you must help to supply and in the expenditure of which you have therefore a personal interest at stake?

As to the claims regarding corruption:

The opportunities for corruption connection with contracts between municipal corporations and private companies for the supply of light are very limited; moreover the prices paid for street lighting in Ontario are not near high enough to sustain a corruption fund.

In municipal ownership, on the other hand, there is a great temptation to crookedness. Mr. Francisco quotes an article from the *Forum* that of the members of a typical city council one third will vote as they think, regardless of advantages, the votes of another third are merchandise pure and simple, and the remaining third are debatable men. This characterization may be somewhat severe; let us hope it is, but there are usually some men in a council who are not above accepting a bribe, and these always endeavor to get themselves appointed on committees having in charge the management of public works. The opportunities for dishonesty are apparent. Besides this there is invariably some preference shown in appointments to office. Mr. Francisco quotes an interview with an official of the Chicago municipal plant in which this gentleman complains that men in his department were turned off without cause to make room for favorites, and that there was "no possible way to get on the service without a political pull."

There are other additional arguments against municipal ownership of lighting plants. The function of a government is to regulate and control and to encourage enterprise on the part of its citizens by extending a protecting hand over the industries they establish. When a number of citizens band together, therefore, to carry on a business which is at best an uncertain one, one in which their works and plant are liable to serious injury from various causes, and in which they are not free to trade where and with whom they choose, but are restricted to localities, a business which confers a benefit to the community and which is already more or less subject to municipal and legislative control, then it is obviously unjust for the municipality to establish and operate a plant in opposition to that of the private company. If a municipal corporation decide to enter into a field of commercial enterprise in which some of its citizens are already engaged, it is only simple justice that it shall offer to take over their works and plant at a fair and equitable price.

Again, the wisdom of a municipality engaging in a commercial enterprise may be questioned, indeed it is a grave question whether the corporation has the moral right to risk the money of its citizens in an undertaking which is attended with such hazards, and in which the advantages to be gained are in any event small and uncertain.

Many cities and towns have been persuaded by incomplete reports and alluring estimates to undertake the experiment, but it still remains to be proven that a municipal plant can supply a cheaper light than a private company In towns which are not arge enough to make the business remunerative the installation lof a plant by the corporation may be justified because street lighting is a public necessity, but where private plants already exist that are able and willing to supply the municipality at a fair price, the outlay cannot be regarded otherwise than as an unnecessary expenditure and a waste of public money.

DUPLEX TELEPHONY.

By T. R. Rosebrugh

In considering this question I propose to do so with reference only to the principles involved, the question of priority of invention of any of these being left untouched.

The name "duplex telephony" though not altogether exact as a description of the methods to which I intend to refer in this paper is nevertheless very near to the meaning.

It will be as well to consider at the outset how the telephone problem differs from that of the telegraph, for one might naturally suppose that the known methods of duplexing telegraphic transmission would be available for the telephone. Actually there is little in common.

The electrical impulses which are used in telegraphy are of definite and predetermined character as to polarity and strength of current while they last, and differ only in their duration and grouping in time, while those of telephony are, of course, from the point of view of the electrician, entirely uncontrollable. Besides this in telegraphy, at the receiving end the only information really given by the sounder, is the interval during which its corresponding key at the transmitting end was raised or depressed, and this is sufficient; whereas at the receiving station the waves of telephone current must be received in very nearly their original form. This means then of increasing the working capacity of telephone lines is not available, while in ordinary practice in telegraphy, the distinction between change of polarity and increase of current, doubles the capacity of the line. In the second place in any system of transmission, telegraphic or telephonic, it is possible so to arrange the circuit that a receiving instrument is shielded from the effect of the transmitter at the same station while responding to that at the distant end. This may be done in several ways, the "bridge" method being most usual; in this method the two wires which enter the station, or the wire and the earth conductor, are connected as though their resistance was to be measured in the usual way, the receiving instrument taking the place of the galvanometer, so that when properly balanced it only responds to the transmitter at the distant end. Three reasons prevent this method from being useful for telephonic purposes: a satisfactory balance would be more difficult to obtain owing to the capacity and self-induction of the line, and self-induction in the instruments at the other end; besides this only a fraction of the current would be employed usefully; and probably more important than either of these, is the fact that while the telegraph may be used for the continuous transmission of messages in one direction, the telephone is intended essentially for conversation, so that even if a pair of simultaneous transmissions in opposite directions over a line were established, a single conversation would demand the use of both.

The third difference consists in the well known fact that on account of the sensitiveness of the telephone the circuit in which it is placed must be as nearly neutral as possible to outside influences both electrostatic and electromagnetic, as well as to the direct action of differences of earth potential; and this can only be done by a return metallic conductor traversing practically the same path as the first.

For these reasons then, it happens that given a single metallic conductor extending between two distant points, with access to an earth connection at both points, used as a telegraph circuit in the ordinary way, four messages may be transmitted simultaneously, yet the same conductor will only suffice for a single conversation in a very unsatisfactory way.

Since two wires are necessary for the proper transmission of one message by telephone it might hastily be assumed that this is a constant ratio, that is that the conductors must always be twice as many as the number of messages that are to be transmitted simultaneously. The fact is, that it is the difference and not the ratio which is constant. There is no doubt for example, that if it were necessary, ten messages could be transmitted simultaneously by eleven conductors without interference, although in that case it is exceedingly doubtful whether the complexity of the system would not preclude its use.

The most natural way of proceeding to increase the transmitting capacity of telephone conductors is to regard the already existing two wire metallic circuits as the units out of which to construct metallic circuits of a higher order, which I will term derived circuits.

It is necessary then that two points be obtained on a two wire metallic circuit, satisfying the condition, firstly, that no difference of potential be produced between them by the action of the transmitters already in that circuit, and secondly, that no effect be produced in the receivers of the circuit by the entrance and exit of current at these two points. The first condition may be satisfied in two ways according to the arrangement of the instruments already in circuit. If intermediate transmitting instruments are to be in series they must be divided into two similar parts, one in each line as in Fig. 1 are D and E, two secondary coils of transmitter T1, arranged so as to contribute at each instant electromotive forces equal and in the same sense with regard to the metallic circuit, and therefore in opposite directions with regard to the line.

If the two sides of the metallic circuit have the same resistance it will be seen that no difference of potential can be produced between the points where the two lines unite, as in Fig. 1 at P1, and the corresponding point at the other end of the line. If, however, the transmitting instruments are only at the terminals or are bridged across between the two sides at intermediate stations, as in Fig. 2, no such modification in their structure is necessary, for their action cannot produce any difference of potential between points which are at the middle of any bridges between the lines.

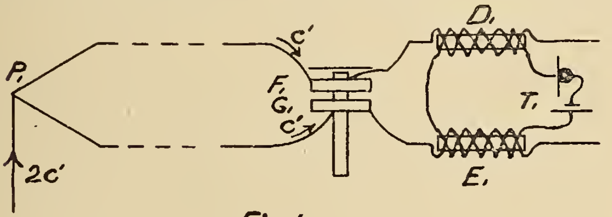


Fig. 1.

It is not true, as might at first be supposed, that every bridge has a middle point, for such a point must divide both the resistance of the bridge, and its inductance, if there be any, into two equal parts, and there will not in every case be such a point. In the case of a secondary of a repeating coil it will be necessary also that the two parts have equal mutual inductance with regard to the primary before the point between the two coils satisfies the condition of having the mean potential at every instant.

Since in any case the currents introduced on the lines of the two wire metallic circuit must divide equally and flow parallel to one another in the same direction, we find the condition that the receiving instruments of the original metallic circuit should not be disturbed by such currents to be, either that the currents should not flow through the coils at all—which may be attained by bridging them between opposite points on the two lines, or, if the introduced current on one line flows through a coil of the receiving instrument, then that on the other line must flow through a coil in the opposite direction, which is just capable of neutralizing the magnetic effect of the first. As for instance in Fig. 1, the introduced current 2c′ entering at P1, divides into two parts c1, which circulate in opposite directions through the coils F1 and G1 of the receiver, and produce no effect, and similarly also in the coils F2 and G2 on the same line. Supposing the bridge method selected as being applicable more generally, let us look at the different ways in which it may be carried out. In Fig. 2, L1 and L2 are two lines which are supposed to be already in use as a metallic circuit, T1 and S1 being the transmitter and receiver at one end, and T2 and S2 at the other. L3 and L4 are similarly two lines of another metallic circuit. Between the points A and B are connected in series two equal non-inductive resistances R. At their common point P1, a wire connects through telephonic apparatus T5 and S5 with P2, a similar wire on the same metallic circuit, including also at the second end the telephonic apparatus T6 and S6; or it may connect with Q1, which is a similar connection on the second metallic circuit, and similarly P2 with Q2, both connections including telephonic apparatus. Each of these bridges has then a resistance 2R, but owing to the line resistance it would generally be incorrect to say that they are equivalent to a single shunt of resistance R. The current on the derived circuit passes through the coils of each pair of resistances in multiple, and each is therefore equivalent to ½R. It is to be noted that currents arriving at A and B from P1, on the derived circuit, do not divide at these points as might be supposed, but that portion of the circuit at the end between A and B, including T1 and S1, is left entirely dead, since, due to such currents, there is no difference of potential between A and B. The same thing applies also to T2 and S2, and to any other telephonic apparatus of this circuit bridged across between L1 and L2, which is not provided with an exit at its middle point.

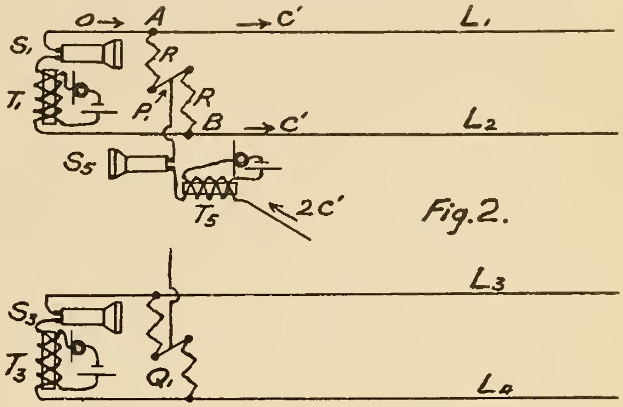


Fig. 2.

As a first improvement on this construction it may be suggested that a self inductive resistance would be better than a purely ohmic resistance, if not connected exactly at the ends of the line, for it would partly compensate the effect of electrostatic capacity between the wires.

The next step in advance is to put the two coils R together on the same core as in a telegraph relay, Fig. 3, so that while the leakage current passing from A to B through the two coils in the same direction around the core, reinforces the magnetism of the core and experiences consequently a high impedance, that from the derived circuit which enters at P, the middle point, and divides there, passing in opposite directions around the core in the two coils, affects the magnetic circuit comparatively little, and has therefore low impedance. In the case of an ordinary box relay of 150 ohms we would have in series from A to B a resistance of 150 ohms, and an inductance of 4.8 henry, while from P1 to A and B in parallel we have 37½ ohms and .49 henry, or to the note "middle C" an impedance of about 7730 ohms to currents leaking through its coils in series, and 790 to the derived currents dividing from the middle point outwards, making a total impedance of 3160 ohms in addition to the ohmic resistance of the derived circuit. Better results than this could be obtained by superimposing the windings instead of having them on the separate limbs of the magnetic circuit. The best possible results, however, will be obtained when the derived current forking at P1 to A and B traverses practically identical courses in opposite directions around the magnetic core, and has therefore a non-inductive path, while the leakage current from A to B passes over this course twice in the same direction, experiencing the maximum impedance. This may be accomplished most exactly by twisting the wires together and winding the double conductor on the coil. A coil made in this way, Fig. 4, measured 480 ohms and 4.6 henry to the leakage current, or an impedance of about 7400 ohms to the note "middle C," while to the derived current entering at its middle point it was practically a non-inductive resistance of 120 ohms. In good modern construction it is necessary on circuits of moderate length to transpose the wires on the poles, in order to expose them equally to outside disturbing influences. In addition to this transposition, to get the best results it is often desirable to transpose the circuits among themselves; this transposition of the metallic circuits is more necessary when derived circuits are formed from them, for in that case transposition on the poles is as important as it is for single conductors to which they are then equivalent. For this reason the derived circuit should not be applied to a pair of circuits differing materially in length.

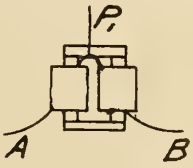


Fig. 3.

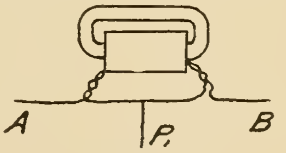


Fig. 4.

The underground cable system connecting stations in the same city affords an excellent opportunity for the application of the above principles, for a large number of metallic circuits between the same two points are in continual demand and are quite expensive. A redistribution of the positions of the wires in the cable being made at every manhole, the transposition must be quite thorough.

Coils such as are indicated in Fig. 4 have been in use in Toronto for some time on the cable between the main office and the Yorkville station ; they afford an extra speaking circuit for each pair to which they are applied, in which as well as in the two original circuits, speech is perfectly transmitted. The same thing is true of a pair of metallic circuits between Toronto and Hamilton, when the circuits are free from long extensions.

It appears quite probable that on very long lines the decreased conductor resistance and self induction of the derived circuit as compared with the originals would fully counterbalance the increased electrostatic capacity, and give, for example, between New York and Chicago, three speaking circuits for every four conductors, instead of two, the transmission being unimpaired in any of the circuits.

A METHOD OF DISTRIBUTION WITH EQUALIZATION OF POTENTIAL DIFFERENCE.

By D. H. Keeley, Mem. Inst. E. E., Ass.-Mem. Can. Soc. C. E.,
Mem. Canadian Electrical Association.

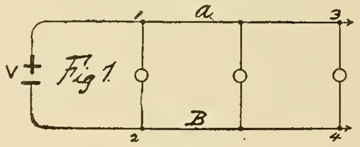
Perhaps it wouldn't be a bad idea to preface what is to be submitted in this paper by a claim that the method of distribution, herein dealt with, affords an equalization of potential difference without increasing the volume or the total weight of conductor in any two-wire system ; and that it affords the same equalization by the addition of only 25 per cent. more wire in any three-wire system, the importance of which latter feature might be emphasized by presenting a reminder of the fact that a three-wire system calls for a conductor that is only as ⅜ is to 1 compared with a system in which but two wires are employed. And since there are adaptations of the method to two different systems of wiring to be considered, it will be convenient to examine them separately after a general survey o

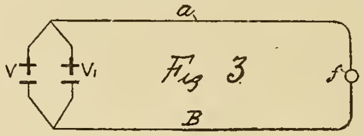
THE GROUNDWORK.

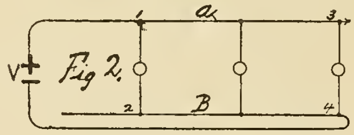
In view of the enormous saving of wire and of lamp life that could be effected by obviating the necessity for a multiplicity of circuits to satisfactorily supply various groups of consumers more or less irregular in their demands, the securing of a uniform E.M.F. at all points of a distribution system is manifestly desirable; and as from what has just been implied it would appear this desideratum can be economically attained, it is thought worth while to present the subject somewhat in the light of a theoretical study, in order that the writer's notions of what leads up to the practical conclusions arrived at may be clearly conveyed. It will be well, therefore, to give some consideration to

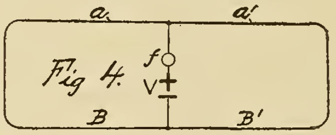
THE PRINCIPLES INVOLVED.

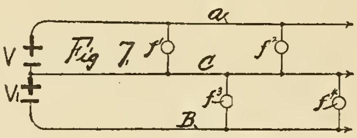
The simple parallel or two-wire system is illustrated in Fig. 1. It will be seen on examination of this figure that the potential difference between the mains A B will fall, owing to absorption of E.M.F. in the mains, the further a given point along their length is removed from the source of current. Hence a lamp or other instrument connected in derived circuit across the mains at 3, 4, will be operated upon by a lower E. M. F. than one connected across the mains nearer the source as at 1, 2, would be.

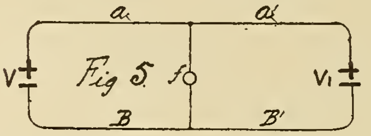


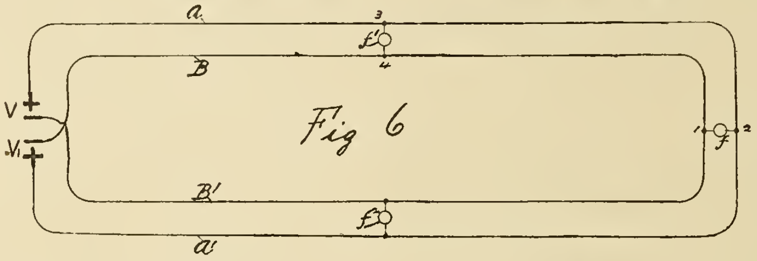


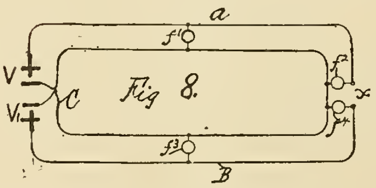


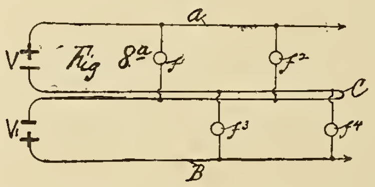












To obviate this difference in fall of potential the simple parallel system is modified, as illustrated in Fig. 2, wherein one of the mains (B) is doubled back upon itself, and the connections are made between the single main (A) and the half of the doubled one (B) that is furthest from the source of current (V). Comparing this arrangement with that shown in Fig. 1, it will be seen that whereas in Fig. 1 a lamp or other instrument connected across the mains at 1, 2, being nearer the source of current as measured along the mains, will receive more E.M.F. than the one connected across at 3, 4, which is further away ; the lamp at a corresponding point 1, 2, in Fig. 2, will only receive the same amount of E.M.F. as the one at 3, 4, because the same total length of conductor as measured along the mains is between them and the source of current.

Hence, with a conductor of the same sectional area connecting similar sets of lamps or other instruments at corresponding distances, it is evident that when the circuits are arranged in simple parallel, as in Fig. 1, the lamp in a derived circuit nearest the source will receive more current than the one furthest away ; and when the circuits are arranged with the doubled main, as in Fig. 2, a uniform current will be supplied to the lamps in the several derived circuits, but this current will not be greater than what is received by the furthest lamp in the former case.

The only result obtained, then, by doubling the length of one of the mains, is the absorption of the E. M. F. that would otherwise operate in excess on any lamp or other instrument in circuit (derived) near the source of current. The additional length of conductor in this doubling of one of the mains is thus shown to be a mere dead resistance in the circuit. This dead resistance with its attendant disadvantages however, it will now be shown, may be eliminated by an adaptation of the fundamental principle that *in a circuit supplied with E. M. F. from more than one source, the current or amperage developed at objective points in such circuit is proportionately contributed to from the several sources of the E. M. F.* An exposition of this principle is afforded by Fig. 3, and it will facilitate explanation to regard the internal resistance of the generators V, VI, as negligible ; and consider only what takes place in the mains A, B, and the lamps or other instrument connected across them at F.

Putting the figures for the generators or sources of current V, VI, at 100 volts each, the total resistance of the mains A, B, at 1 ohm ; and the resistance of the lamp, or other instrument through which the circuit is completed, at 99 ohms; the current developed with only one of the generators (V) connected in circuit is $\left\{\frac{100 \text{ volts}}{99+1 \text{ ohms}}\right\}$ 1 ampere, and its production (1 x 99) 99 volts is absorbed in the lamp or other instrument F, and (1 x 1) 1 volt is absorbed in the mains A, B. If now both of the generators V, VI, are connected in parallel, in the circuit as shown, the potential difference of 100 volts at their junction with the mains A, B, will remain unaltered. The current developed in the circuit, and the allotment of absorption will therefore remain the same as before ; but it is evident that in this case the work is shared by the generators V, VI. The out-put of each of them respectively is only half of what it would be were it acting alone, and the practical effect is the same as if the circuit resistances were doubled by the presence of the second generator.

Bearing this in mind, a further view of the fundamental principles involved will be found in a comparison of Figs. 4 and 5.

When a double circuit is arranged, as in Fig. 4, with a single source of current, V, it is evident that the current generated by V will circulate in both divisions of it ; +V, F, A, B, V –, and +V, F, A′, B′, V –, and if the circuit wires A, B, and A′, B′, are alike, the amperage will be the same as if there were but a single circuit with a wire (A, B,) of twice the sectional area of A, B, or A′, B′.

From this it follows that when a double circuit is arranged, as in Fig. 5, with two equivalent sources of current V, VI, the resultant amperage manifested in the lamp or other instrument F, conjointly supplied by them, will be determined not by the separate resistances of the two divisions but by the joint resistance of the circuit wires A, B, and A′, B′. Hence with a double circuit so arranged, the wires used need have only half the sectional area of what would be required in a single circuit to produce the same result.

It is seen then with the aid of these figures, 3, 4 and 5, that in a double circuit supplied with current from two equivalent sources, the current emanating from either source is only half of what it would be were it operating alone in a circuit of the same resistance. It is further seen, however, that the halving of the E.M.F. from each source begins only at the point where the leads from the sources of current connect with the conductors in which the currents conjointly operate ; hence, the half of the current is in each case transmitted by the full E. M. F. from its source. And it is also understandable from the foregoing that the total amount of absorption or drop of the E. M. F. in the leads, from the sources of current up to the point of junction with the conductors that convey the current to the lamps or other instruments, is determined by the joint resistance of these leads and is, therefore, only half of what it would be were the current transmitted from one source alone.

THE TWO-WIRE PLAN.

Now with these three conditions obtaining, it becomes practicable to arrange a complete system of distribution according to the plan of Fig. 6, and it is something remarkable to find, as will be seen from a merely superficial inspection of that figure, that the method thus evolved virtually consists in splitting the two mains of the simple parallel system described in Fig. 1, so that four wires, of the total sectional area of the two therein shown, are obtained, and these are so connected with the sources of current that an equalization of potential is secured throughout the system without involving the use of the additional volume of conductor comprehended by the doubling of the main B, in Fig. 2, that has heretofore been necessary to attain the same end. For, to follow up the examination, if, in Fig. 6, the point of junction, of the leads from the sources of current, V, VI, and the circuit to be supplied, is taken to be where the lamp F is connected across, it will be seen that the + phases of the currents from V, VI, traverse the mains A, A′, to the point 2, while the – phases of the currents traverse the mains B, B′, to the point 1 ; and these + and – phases conjointly produce, through the joint resistances of A, A′, on the one hand, and of B, B′ on the other hand, a potential difference between the points 1, 2, that will affect the lamp or other instrument in derivation (connected across between the mains) at F, in precisely the same way and to the same degree that it would be affected were + and – phases received from V alone through a single pair of conductors the sectional area of which corresponded to the combined sectional areas of A, A′. and B, B′, or twice the size of A, and twice the size of B. Again, if, in Fig, 6, the point of junction of the leads from the sources of current and of the circuits to be supplied, is taken to be where the lamp, F′, is connected across, it will be seen that the difference of potential between the points 3 and 4 is the same as between 1 and 2, and obviously the same potential difference will be found everywhere throughout the system, because the conditions of the current distribution from each of the sources, V, VI, is precisely the same as that already described at length with Fig. 2 : for the same total extent of conductor exists between the points 3 and 4 and the sources of current, V, VI, respectively, as exists between the latter and the points 1 and 2. Hence, the effect of the currents emanating from the sources V, VI. is uniform throughout the mains, and the equalization of the difference of potential is rendered absolute.

THE THREE-WIRE PLAN.

It will now be in order to go on and find that what has been thus far under consideration as adapted to a two-wire system, is equally adaptable for current distribution according to the well known three-wire system; thereby securing for it an equalization of potential difference at all points.

The distinguishing feature of the three-wire system represented in Fig. 7, as compared with the simple parallel, Fig. 1, is that in the three-wire system the current for a given number of lamps is transmitted in two circuits, each of them embracing half the number, whereas in the single parallel the whole number is supplied in one circuit.

As at present in operation, there is in the three-wire system (Fig. 7) a fall of potential all along the leads constituting the main conductors from the sources of current. In the figure (7) V, VI, are the two generators or sources of current connected in series between the mains A and B with a neutral return wire C common to them both. It will be understood without repetition, what has already been gone over, that the action obtaining in either circuit is the same as what obtains in the simple parallel, Fig. 1, and what is needed to be introduced is the equalization of the potential difference between the mains as affected by the plan described with Fig. 2. This combination is effected in a practical way as represented in Fig. 8 [Fig. 8a shows electrically the same combination but in a form that can hardly be looked upon as practically available] and it will readily be seen in view of what has already been established by the aid of Figs. 1 and 2, that the neutral return wire, although doubled, is still common to both circuits for the currents emanating from V, VI, while at the same time the lamps or other instruments F1, F2, and F3, F4, are all equidistant from the sources of current as measured along the conductors, and are therefore supplied with current at a difference of potential which is the same for all points of the system.

By this combination, therefore, the three-wire system is made to afford the same advantageous result as is attained by the other method of construction that has been considered, but it will be seen that it is arrived at in a distinctly different way in each case, and is due to the operation of two different principles underlying the problem of current distribution. For, according to the first method, each of the two sources of current contributes half of the resultant current operating in each and every lamp or other instrument embraced in the system; while according to the method comprehended in the three-wire system each of the two sources of current separately supplies half the number of lamps or other instruments embraced in the system, supposing the total number to be evenly divided between the two circuits. At the same time it is seen that this combination whereby the equalization of potential difference is secured for the three-wire system virtually consists in separating the sources of current, V, VI, and introducing between them (Fig. 8 or 8a) a loop constituting a return conductor common to both circuits, instead of having them joined directly in series (Fig 7) and tapping the junction with a single conductor to complete the circuits as heretofore. And again it so works out that the arrangement of circuits shown in Fig. 8, while, as we have seen, depending on totally different conditions for its operation, is precisely the same as that shown in Fig. 6, excepting that the outer main, A, A1, is cut or divided at the point X. This disruption throws each of the two sources of current, V, VI, into separate circuits, and obviously it is immaterial, as far as the operation is concerned, whether the sources, V, VI, are opposed or in direct series, but it is preferable to put them in opposition, as shown in the figure, in order to obviate the excessive potential difference that would otherwise obtain between the ends of the loop common to both circuits and necessitate the doubling of its sectional area for a given drop in the E. M. F. transmitted. Similarly it is recognizable that the electrical conditions obtaining in the arrangement of circuits shown in Fig. 6 would obtain in the arrangement shown in Fig. 8a, if the extremities of the mains, furthest from the sources of current, in Fig. 8a were joined together. If so arranged, however, the circuits would evidently be complicated and unwieldy, whereas when arranged as shown in Fig. 6 and Fig. 8 the circuits according to

BOTH PLANS

are simple and flexible and afford the greatest degree of convenience, in that two wires, leads or mains, may be carried from the sources of current in any desired direction through a given building or district and by another route returned to the sources of current, and these two mains may be tapped at any number of points and the same potential difference will be found to obtain between them at all points, whether in close proximity to, or at the furthest distance from the sources of current. Hence, there is hereby afforded a means for knowing at a supply station the actual conditions of supply at any moment in a given circuit; for, if an indicator of any suitable description is connected between the mains at the station, it will show the difference of potential obtaining, and if the circuit demands an increased current at any time, the fall of potential difference due to increased absorption of E. M. F. in the mains will be instantly shown by the indicator which will necessarily be affected in a measure corresponding exactly to what is taking place at every point throughout the system. It will of course be readily conceived that as regards the sources of current, these may be of any form of direct current generator or may be the secondary wires of separate converters or transformers, or separate secondary wires on a single converter, the primaries or primary of which are or is in circuit with a source or generator of alternating currents; and that this method of circuit construction constitutes at once, in either of its forms, Fig. 6 or Fig. 8, a system for the distribution of current direct from a generating station, or a system for either primary or secondary circuits or both primary and secondary circuits for alternate current distribution.

A STEP FORWARD.

Now, having got to the bottom of the whole idea and acquired an exact knowledge of the results attainable by an arrangement of circuits in either of the two ways described, we can rise to a proper appreciation of its utility, and the first question to be asked will naturally be: How is it, this method of circuit construction has not been heard of in practice? Well, the fact of the matter is it hasn't had a chance to put in an appearance. In the shape here presented for consideration, it may not improperly be regarded as something brand new and original. It is offered in that sense. But the surprising fact obtains that one of the plans has already reached the hoary age of three years, for precisely the same arrangement of circuits as is shown in Fig. 6, is found to have been anticipated in a U. S. Patent granted as far back as 1891. Unfortunately for its development the plan as patented appears to have been arrived at along a line of reasoning different from that which has been followed in this paper, and the specification shows that the inherent virtue of the arrangement has been handicapped by a little over-dressing in the shape of a "preferred form" comprehending a cross-wire that practically relegated the improvement back to the operative conditions of the simple two-wire circuit. While this is to be regretted, it cannot be said to have done any more harm than a dam does to a river Water eventually finds its level, even if driven to the opening up of new channels to that end; and in the same sense the attainable in our electrical field forces its way through our minds and brings whatever is of utility to the surface. That's how it comes about that inventions are re-invented and conceptions are re-conceived. In the present instance, the writer was for awhile under the agreeable impression that the method we have been examining according to both plans had been devised solely by himself, until it was found some of the ground had been already covered in the way that has been mentioned. However, it is hoped a step forward is about to be achieved. The opportunity to bring the matter to the attention of this useful and progressive Association was embraced with grateful enthusiasm; and if this paper is provocative of any profitable discussion, whatever expectations are entertained of an early and widespread adoption of these plans will in all probability be realized.

ELECTROLYSIS.

By Jas. A. Baylis.

"Electrolysis" has been announced as the subject of my paper, but it is too comprehensive a term to be applied to it, as it is to the electrolytic corrosion of underground pipes and electrical conductors by stray earth currents, that I wish to confine my remarks.

During the last year or two the attention of the electrical fraternity, and the public generally, has been frequently and forcibly directed to this subject, and several interesting and valuable articles and papers have appeared in the columns of the electrical press, or have been read before electrical societies. Up to the present time, however, no paper on this important matter has been presented to our Association, and I believe that a thorough discussion of the subject at this meeting will be productive of much good to all interested; if my paper (for which I do not claim much originality) serves as a basis for such discussion, it will have well served its purpose. In preparing it, I have freely consulted the transactions of the various societies and the columns of the technical press, and must acknowledge the great aid they have been to me in so doing. This paper, therefore, is more of a resume of what has been done by others in this field, than the result of personal experience.

One of the first places to suffer from the evil effects of stray earth currents was Boston, Mass. Almost three years ago the New England Telephone and Telegraph Co. found that the insulation of some of their underground cables had broken down; upon investigating, it was discovered that the lead sheathing had been eaten through in spots in some of the manholes. The matter was carefully looked into, and it was proved beyond a doubt that the current from the rail side of the street railway circuit had leaked on to the sheathing of the cables at various points, and leaving the cables at others, had, at the points of leaving the lead, eaten it away to such an extent as to allow water to penetrate to the core, thus destroying the insulation of the wires.

It was soon found that the destruction of the telephone cables was but an item of the damage being done by these stray currents; water and gas pipes were being eaten through in a number of towns in which single trolley street railways were being operated. After careful experiment it was shown that only where the current left the pipes to pass to earth (i. e., where pipes were electro-positive to the earth) was any damage being done. The explanation given and the one generally accepted as correct was that electricity passing through a conducting liquid from the anode to the cathode, decomposes the liquid, and in the case of water which contains enough foreign matter to make it a conductor, the hydrogen is carried, as it were, and liberated at the cathode, while the oxygen is set free at the anode, which, if it be of an easily oxidizable material, will soon be attacked, nascent oxygen being a very active agent.

The truth of this has lately been questioned in a most interesting and valuable paper on this subject by Prof. D. C. Jackson, read before the Western Society of Engineers, July 11, '94. After a series of careful experiments Prof. Jackson came to the conclusion that the oxydation of the metal as before mentioned played an unimportant part in the destruction of the pipes and that the corrosive action was due entirely to the electrolysis of the substances held in solution in the water of the soils. The gravity of the corrosion of the pipe depends on the amount of current flowing from a given area and the nature of the salts in the soil.

What happens in the case of buried pipes is this:—the current which has leaked rom the rails passes on to the pipes, and will leave them and flow to earth at points from which the resistance of the earth circuit to the power house is less than by the metallic one. The soil of cities contains more or less moisture holding in solution chemicals, which, when their components are set free, are of a more or less corrosive nature.

To decompose acidulated water between two platinum electrodes an E. M. F. of about 1.5 volts is necessary; with lead plates a smaller voltage; and with iron and zinc still less, as the affinity of the metals enters into the reaction. Metals buried in moist earth containing impurities may be about at the point of corrosion, a very slight potential difference being enough to set up marked action. This accounts for the destruction of pipes where only a fraction of a volt P. D. was found between them and the surrounding earth; because the P. D. is under one volt is no surety that action will not take place, not so rapidly or violently of course, but just as surely.

What forces the current to leave the rails and pass to the earth? Undoubtedly because of the too high resistance of the rail circuit, due to imperfect bonding; either the bonds are too small, or, what is more likely, the contacts between the rails and the bonds are not good. Sometimes the rails are connected to the water pipes of a town; if this is done care must be taken to have the water mains connected to the dynamo at the power house, otherwise if the negative pole of the dynamo be grounded or connected to the track, a path of low resistance has been provided for the current to get on to the pipes, but to return to the dynamo it must pass through the earth, and damage is sure to follow.

Very many remedies have been suggested and tried. Here are some of them:—

1st. Grounding the positive pole of the dynamo and putting the negative to line. This only has the effect of changing the location of the district in which the pipes are positive to the earth from the immediate vicinity of the power house to more distant points, and while the action is not so violent, it is spread over a much larger area and the trouble is much more difficult to deal with.

2nd: Breaking the metallic continuity of the pipes and cables has been suggested. This is impracticable, of course, not only because of the enormous expense of changing all the pipes at present in the ground, but from the fact that current would leave one section of pipe, pass to earth, and back on to the next section.

3rd. Frequent reversals of the polarity of the street railway currents. This would only retard the action, not stop it altogether. Various other more or less impracticable remedies have been proposed, but it will be unnecessary to notice them.

The only sure cure for this trouble, as far as we know at present, is in the adoption of some other street railway system than that of the single trolley with track return:

such as a double trolley system, storage batteries, or alternating currents, if a practical motor can be constructed. A method of street railway construction was described by Mr. W. Nelson Smith in the Street Railway Gazette of Feb. 17, '94, which does away with the track return, being practically a double trolley road, operated under the three wire system, using the earth and rails as a neutral. Another system was described by Mr. Nelson W. Perry in the Engineering Magazine for March, '94. Many, if not all, of the proposed underground conduit systems would have as an additional recommendation, freedom from attendant electrolytic effects.

The discussion of the merits or demerits of these various systems, their practicability or impracticability, is outside the province of this paper; suffice it to say, that there seems to be more than one way of operating street cars, without destroying pipes, &c., already under ground.

Nevertheless, the fact remains, that there are very many single trolley roads in operation in this country, and that something should be done to protect the pipes of the municipalities under whose franchises the street railway companies operate.

Absolute protection, as far as is known, it is impossible to have, but to ensure the greatest freedom from destructive action, the track circuit must be of the lowest possible resistance. This can only be accomplished by the best of bonding and frequent cross connections of rails. Electrically welded rails should be of great service in this connection. The rail circuit should be reinforced by overhead returns connected to the rails at intervals, as is done with the trolley and feeder wires. The negative pole of the dynamo should be grounded, and the various systems of underground pipes connected to it by conductors of large carrying capacity.

These are the principal safeguards that can be adopted.

The telephone companies having underground wires have been among the sufferers from the electrolytic corrosion of the lead of their cables, and a brief description of the method used in the United States for their protection may be of interest.

A map of the underground conduits and manholes is made, and on it are marked the differences of potential between the cables in the manholes and the earth, also the direction of the current, whether to or from the cables. In this way the "danger district," or section where the cables are positive to the earth, may be seen at a glance. In this district, the sheathings of the cables are carefully connected together by large wire, and a heavy wire (or wires) is run from the negative pole of the dynamo, which is to ground, to the nearest manhole in the danger district, and if the current is of great volume, to several of the manholes. As far as I know, in every case, this has changed the direction of the current, causing it to flow from the earth to the cables, thus giving adequate protection in an inexpensive way. Unfortunately all pipes cannot be protected to the same extent in the same way, and the responsibility of doing proper track construction rests with the street railway companies.

Finally, because in a town there may be but small differences of potential between pipes and the surrounding earth, and decomposition of them does not set in as soon as the street railway current is turned on, we should not be deceived into a feeling of false security, for though the destructive action may be slow in coming, come it will, none the less surely.

NOTE ON POSSIBLE REDUCTION OF STATION PLANT ON SMALL ELECTRIC RAILWAYS BY MULTIPLE SERIES CONTROL OF MOTORS.

By John Langton.

The only efficient method of controlling electric street cars is to vary the volts at the motors according to the speed required. The facility for doing this with storage batteries, by means of grouping the batteries differently, is one of the strong points of battery traction. In a trolley or conduit system with constant line pressure the same thing is arrived at by grouping the motors in series or in multiple. With only two motors to deal with, as in an ordinary street car, this makes rather an abrupt stop, which is eased off to a more gradual change by slowing them down by a resistance in series, or speeding them up by cutting out part of the field winding or shunting it by a resistance. This method was used in the early days of electric railroads, but was abandoned, not because it failed to give the results expected, but because it introduced a new complication at a time when there were so many troubles with everything, that simplification was the pressing need. These early difficulties having been surmounted, multiple series control has been successfully revived.

The figure usually accepted for traction on street railway tracks in average condition, is 30 lbs. pull on the drawbar per ton weight of car, moving on a straight and level track. To start the car from rest requires a much greater effort. Dynamometer experiments show a starting pull of from 90 lbs. to 120 lbs. per ton, equal to the traction needed for ascending grades of 3% to 4½%.

When the car is started with the motors in parallel, controlled by the simple process of wasting in a rheostat the volts that are not needed at the motor terminals to give the amperes required for the traction, the demand on the station for power is greater when the car is being started than at any other time of its run, except on roads with heavy grades. But putting the motors in series for starting greatly reduces the power required. The torque of the armature, which gives the traction, is a matter of amperes, and with the motors in series the same traction is obtained with one half the current from the line required when the motors are in parallel. The power consumption from start to full speed is rather more than one half, apparently because the accelerating force is more irregularly applied, so that it takes rather longer to get up to speed; or to put the same thing another way, in order to get up to speed in the same time, rather more than half the average amperes are needed for motors in series, as compared with motors in parallel. The actual figures seem to be about two-thirds the maximum power, and two-thirds the total power consumption, in starting and getting up to speed in the same length of time. This method of starting then takes a maximum current, which if divided between the motors in parallel would only give the traction needed for ascending grades of from 1% to 2%, and as almost every road has steeper grades than these, the heaviest power demand on the station comes, not from starting, but from moving up grade at full speed. But if we are content to go up such grades at a considerably reduced speed, we can get, as in starting, the necessary traction with half the amperes, by putting the motors in series. The motors are then working with good efficiency on half the line volts and running at about half speed. There is of course no saving in the total power consumption—the energy; the car takes half as much current, but also takes twice the time to cover the distance. But there is a great reduction in the maximum power required, which would be about the same on a 5% grade with motors in series as on a 2% grade with motors in parallel, or about the same as the maximum power required for starting with motors in series. The motors must carry the same current in either case and must therefore be the same size, but the maximum demand on the power station from any one car is reduced nearly one-half.

On large roads the principle of averages may be relied on to a great extent, and the station capacity per car may approximate the average power taken by the car, but on small roads it is in general only safe to provide a station capacity per car of very near the maximum car demand. On small roads, therefore, a reduction of the latter means a reduction in size of station plant. Even if the station capacity per car of large roads were appreciably affected by multiple series control it could hardly be availed of. The most valuable reduction is that on grades, which may last for some minutes whilst starting is a matter of a few seconds. But rapid transit is a principal reason of the existence of large electric roads and a prominent source of their income, and they cannot afford to go slowly up hill. For large roads the principal value of multiple series control is the ability to run slowly with good efficiency in crowded streets, and the saving of wear and tear on switch and rheostat at such times and at starting. On small roads with a few cars running on fifteen to twenty minutes headway is more a question of communication than of continuously rapid transit; and, as has been shown, by sacrificing speed up hill a substantial reduction in the first cost of power plant may be achieved, without any sacrifice of ability to run at high speed on the level and low grades. The horse power hours drawn from the station would be the same per car trip in either case, but by easing off the starting current and slowing up on grades, the power would be drawn more uniformly, with the tendency to reduce the variations of load on steam engines. This should give better economy in steam consumption, but it is not at all probable that there would be any noticeable effecs on the coal bill. The load diagram of the station would still be badly serrated, but the peaks of the diagram would be of more uniform height, and the highest of them lower than with motors always in parallel.

There is nothing new in this paper, and the facts and conclusions seem fairly obvious, but similar simple engineering considerations are continually either not observed or not appreciated in projected works, with the result of paying an extravagant price for some quality which brings in an inadequate or no return.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

PROCEEDINGS OF THE FIFTH ANNUAL CONVENTION.

The most successful Convention in many respects that the above Association has ever held, took place in Toronto last month. The proceedings of this fifth annual Convention of the Association extended over four days, commencing September the 5th and closing on the 9th. The deliberations of the Convention were presided over by the Executive President, Mr. Geo. Hunt, of Montreal.

The delegates present representing the various Subordinate Associations throughout the Dominion, were as follows :—

J. Robertson, H. Nuttal, and J. Murphy, from Montreal No. 1; R. Drouin and A. Menard, from St. Laurent (Montreal) No. 2; E. C. Johnson and E. Robertson, from Hamilton No. 2; E. J. Philip, A. M. Wickens, W. Phillips, N. V. Kuhlman, and G. Fowler, from Toronto No. 1; Jas. Walker, from Kincardine No. 12; Wm. Jamieson, from Dresden No. 8; W. Wilson, from Peterboro' No. 14; C. J. Jorden, from Guelph No. 5; J. Devlin and R. King, from Kingston No. 10; J. F. Cody from Wiarton No. 13; J. R. Uttley, from Berlin No. 9; F. G. Mitchell and Thos. Mungall, from London No. 5; J. H. Thomson and T. Wensley, from Ottawa No. 7; Arthur Ames, from Brantford No. 4; Thomas Ryan, provincial deputy for Quebec; A. E. Edkins, provincial deputy for Ontario; A. M. Wickens, district deputy for Toronto, and F. G Mitchell, district deputy for London; George Hunt, executive president; Wm. Sutton, executive vice-president; W. G Blackgrove, executive treasurer, Thos. King, conductor, and F. Robert, doorkeeper.

Richard Shapland, London; O. E. Granberg, Montreal; John Campbell, Montreal; J. Langdon, Hamilton; R. Stuart, Hamilton; W. F. Chapman, Brockville; Oliver Shantz, Geo. C Mooring, W. L. Outhwaite and others, were present as visitors.

In the absence of Mayor Kennedy, Ald. Burns extended to the Association on behalf of the city of Toronto a hearty welcome, and invited the delegates to take part in a carriage drive and luncheon at Reservoir Park, for which preparations had been made by the Council at 10 a.m. on the following day. He had no doubt they would see much while in the city to interest them and call forth their admiration. He referred to the fact that ex-Ald. Bell, of Toronto, was now a member of the C. A. S. E. The following reply, drafted by Bros. Ryan, Jamieson and King, was read :

> 'We, the undersigned committee, on behalf of the fifth annual convention of the Canadian Association of Stationary Engineers, held in your city in 1894, in reply to your address of welcome so cordially extended to us by Ald. Burns, beg leave to express the most sincere thanks of our convention for the hearty welcome extended, and the preparations made by you for our entertainment and pleasure during our stay in your beautiful city. We esteem these courtesies all the more from the fact that this is the first time that our conventions have been officially recognized by any civic body in this manner. Trusting that Ald. Burns and confreres may long be spared to look after the interests of the Queen City of the West."

Ald. Burns retired amid hearty applause.

Bro. E. J. Philip, President, of Toronto No. 1, on behalf of the local association, heartily welcomed the delegates. In doing so he referred to the fact that Toronto was the birthplace of the organization, the first association having been formed there with only eight members, The present large attendance was a satisfactory evidence of the growth of the Association.

After the reading and confirmation of the minutes of the last meeting, the following committees were appointed :

Auditing Committee—Bros. D. Robertson, chairman; Robert King, C. C. Robertson, C. J. Jorden and A. Menard.

Constitution and By-Laws—Bros. James Devlin, chairman D. Robertson, A. Ames, F. Robert and R. Drouin.

Good of the Order—Bros. J. F. Cody, chairman ; Robert King, E. C. Johnson, F. G. Mitchell and Ed. J. Philip.

Mileage—Bros. Joseph Robertson, chairman ; J. H. Thompson, F. W. Donalson, E. C. Johnson and E. J. Philip.

Credentials—Bro. W. G. Blackgrove, chairman ; A. E. Edkins and A. M. Wickens.

The annual address of the President, Mr. Geo. Hunt, read at this stage, was as follows :

I have the honor to welcome you to this our fifth annual convention of the Executive Council.

I do this knowing that your lodges in selecting you as their delegates have done so that you will do what you consider best, and to the advantage of our beloved order ; and feeling that it will be the most important meeting ever held by our society, not only on account of the greater number of lodges represented, but also because of the magnitude and importance of the subjects to be brought forward. May our proceedings and deliberations on the various subjects be so conducted as to be to our credit, and that harmony and good-will may prevail throughout our session.

I trust you will accord me the hearty support that has always been granted by you to the occupant of this chair, and which will result in profit to ourselves and increased prosperity to our order.

We have, during the past year, made gratifying additions to the number of our lodges, four of which have been instituted, and my experience has been that the organizers have very generally adhered to the principles of careful selection of members and useful officers, and I here tender my heartfelt thanks to the many brethren who, though often so little known, have quietly spread the tenets of our order, and as a result founded new lodges.

Whilst we have added largely to our membership, substantial progress and improvement has been made in the general conduct of the lodges ; the officers perform their duties more intelligently, and the ritualistic and secret work is done better. I am pleased to hear that in many lodges the use of books is not necessary, and when caution is used to avoid straying from the text, the result will be added impressiveness to the ceremony and increased respect for the officers.

There is a growing desire on the part of brethren to make lodge meetings more enjoyable by the introduction of lectures, discussions, music and other educational methods, and I find that where this system has been carried out most successfully there is greater harmony and less unnecessary argument, better attendance, more initiations and a nearer approach to perfection in the work than in lodges that make no effort in this direction.

I am pleased to report that many of the district deputies have done yeoman service, and have been of great assistance to the grand executive.

Some deserve special mention. They have given evidence of an enthusiasm in the performance of their duties and an interest in the well-being and growth of the order, which should earn for them the gratitude of this grand body. I am of opinion that their valuable assistance, and especially the persevering and successful efforts of the majority, have not received the recognition which they deserve.

The order is now becoming too large and widespread to be handled, as in earlier years, directly by the executive, and as a necessary consequence the duties of the district deputies will become more onerous and the office more responsible. It is therefore imperative that the appointments be judiciously made, their duties clearly defined, their annual report duly handed in and their services receive more recognition.

In conclusion, brethren, allow me to admonish you to be ever watchful of our order, guard well the doors of the lodge, cause strict examination to be made into the character of all candidates, suffer none to be admitted whose reputation is not pure and spotless. Recollect that the future success of our order depends very much more on the character than the number of its members. I feel exceedingly grateful to you for the honor conferred upon me a year ago when you elected me to the very honorable position of president of this society, so deserving of the patronage of our fellow-countrymen

Brethren, I have already occupied too much of your time and attention with such remarks as seemed to me applicable to the present occasion, and will, therefore, only add, in closing, that it is my heartfelt wish and desire that your deliberations at this meeting may be so conducted towards each other that whatever we may do will redound to the honor of the C. A. S. E. Commending you to ask wisdom in your legislation from that Great Being who rules and guides us in our every thought of word and work. All of which is respectfully submitted.

Bro. Edkins presented the report of the committee on credentials, which was found satisfactory.

The report of the Secretary, Mr. John J. York, stated there have been formed during the past five new associations, viz.: Kingston, Winnipeg, Kincardine, Wiarton and Peterboro', with a total membership of 115. All the new associations are founded on the best possible basis, with men of well-known ability, sound judgment and integrity, at the head of affairs. An improved form had been prepared for the use of secretaries of subordinate associations in sending in their semi-annual reports. The system of book-keeping in use by many of the associations was very defective, and something better should be insisted on. Notwithstanding the dullness of the times, the membership and finances of the several branches had increased, as showc by the following statement :

Name of Association.	Members, 1893.	Members, 1894.	Inc.	Dec.	Cash, 1893.	Cash, 1891.	Total Assets, 1891.	Liabilities, 1894.
Toronto No. 1	80	112	32	...	$316 14	$467 89	$617 89	......
Montreal No. 1	76	75	...	1	120 17	190 66	806 66	......
St. Lawrence No. 2	60	60	...	...	68 92	28 85	40 85	$25 00
Hamilton No. 2	35	31	...	4	2 90	5 45	163 59	76 30
*Stratford No. 3	...	...	...	...	......	......	....	......
Brantford No. 4	15	15	...	...	......	......	....	..
London No. 5	25	15	...	10	11 52	5 11	...	..
Guelph No. 6	16	16	...	...	32 51	41 11	...	......
Ottawa No. 7	33	36	3	...	45 85	52 86	....	
Dresden No. 8	18	17	...	1	66 16	23 22	....	.....
Berlin No. 9	14	12	...	2	......	......	....	.....
†Kingston No. 10	...	39	...	...	..	......	....	......
Winnipeg No. 11	...	40	...	...	......	......	....	......
†Kincardine No. 12	...	7	...	...	......	1 05	6 80	0 63
†Wiarton No. 13	...	15	...	...	.	.. ..	....	..
†Peterboro No. 14	...	14	...	...	......	.	....	......
	372	504	132					

* No report.

† New associations.

The report was received and referred to the Auditing Committee.

The annual report of the Treasurer, Mr. W. G. Blackgrove, for the year ending September, 1894, was as follows :

Receipts.

8th Sept., 1893,	balance on hand	$210 71
13th " "	stationery (Berlin)	70
28th Oct., "	per A. E. Edkins, Kingston charter	15 00
12th Jan., 1894,	Toronto No. 1 per capita tax	22 50
13th Feb., "	cash, J. J. York, ex-secretary	96 50
15th June, "	per A. E. Edkins, Wiarton and Peterboro' charters	30 00
9th July, "	A. M. Wickens, Kincardine charter	15 00
24th Aug., "	stationery Toronto No. 1	1 40
30th " "	Toronto No. 1 per capita tax	28 00
3rd Sept., "	cash, J. J. York, ex-secretary	120 61
		$540 42

Disbursements.

9th Sept., 1893,	mileage rates	$161 55
" "	rent of hall for convention	5 00
2nd Nov., "	A. E. Edkins, expenses, Kingston	2 00
4th Dec., "	J. J. York, for emblems	50 00
8th Feb., 1894,	" postage and express	5 23
9th July, "	A. M. Wickens, expenses, Kincardine	9 50
28th Aug., "	Toronto No. 1, on account	25 00
		$258 28
	Balance cash on hand	282 14
		$540 42

The report was referred to the Auditing Committee.

On motion of Bro. Edkins, seconded by Bro. King, it was decided to send, through the President, a telegram of congratulation to the National Association of Stationary Engineers of the United States now sitting at Baltimore. The Executive Secretary read a letter from that Association regretting their inability to be officially represented at the dinner, but wishing the sister organization all prosperity.

A letter of regret was read from Bro. Hartenstein, of Montreal, who could not be present.

An invitation was given the members by Bro. Philip to inspect the steam and electric plant of the T. Eaton Co.

The committee on good of the order reported recommending that the charter for Brandon be recalled, and that a new charter be issued in the case of Portage la Prairie, should a branch be formed there. In the case of the Stratford branch, it was recommended that the district deputy be asked to visit them, with a view to reviving the branch.

The report was adopted.

The district deputy for Quebec, Bro. Ryan, stated that he expected to organize associations shortly at Sherbrooke, Quebec and Levis, and an interesting winter's work was in prospect.

The district deputy for Ontario, Bro. A. E. Edkins, reported that new associations would probably be formed at an early date in Brockville, Carleton Place, Chatham, and other Ontario towns.

Mr. W. F. Chapman, of Brockville, announced his purpose of doing all he could to institute an association in that city.

EVENING SESSION.

At the open session in the evening, papers were read by Bro. J. Murphy, of Montreal, on " Steam Jackets and Steam Separators," and by Bro. O. E. Granberg, of Montreal, on " Stationary Engineers, Real and Imaginary," for which the authors received a hearty vote of thanks. At 9.30 a visit of inspection was made to the power station of the Toronto Electric Light Co.

SECOND DAY.

Wednesday was enjoyably spent in viewing the city and the Industrial Exhibition from carriages placed at the disposal of the visitors by the City Council, luncheon being partaken of at Reservoir Park. In the Board Room of the Industrial Exhibition Association, an interesting paper was read by Bro. A. E. Edkins, on " Injectors," which will be found on page 120 of this issue.

THE ANNUAL DINNER.

The annual dinner took place in the spacious dining hall of the Palmer House on Wednesday evening, and was an occasion of much enjoyment. The chair was occupied by Bro. E. J. Philip, President of the local association. Among the visitors were Mr. Joseph Tait, ex-M. P. P., and Mr. J. J. Wright, Manager Toronto Electric Light Company, and President of the Canadian Electrical Association. Letters of regret were read from Mayor

Kennedy and Mr. O. P. St. John, President of the Marine Engineers' Association.

After sufficient time had been given for the discussion of an excellent menu, the lists of toasts was proceeded with. The toasts, "The Queen," and Canada Our Home" were honored by the singing of the National Anthem and The Maple Leaf.

Mr. Joseph Tait in replying to the latter toast, referred to his efforts to secure the legislation which the Association desired, and regretted that he had not been more successful. Such legislation was now difficult to obtain owing to the abuse of their privileges by certain classes.

A fitting acknowledgement of the toast "Toronto, the Queen City of the West," was made by ex-ald. Bro. Wm. Bell.

Mr. Samuel Rogers replied on behalf of "The Manufacturers," expressing his sympathy with the men, who in this organization were endeavoring to educate and fit themselves for higher positions. By keeping a good purpose before them, he trusted they would find chances of climbing up the ladder, and that they would all achieve an honorable position in life.

Mr. John J. Main, responding to the same toast, said he could observe in the faces of the members of the Association year after year their growing intelligence. The Association should bring young men in, and try to educate them and make them capable.

The toast to "Kindred Societies," was responded to by Mr. J. J. Wright,—who extended an invitation to as many of the members as could do so to visit the convention of the Canadian Electrical Associaton in Montreal—by Mr. J. C. McLean, of the Toronto street railway, and Mr. John Campbell, of the Montreal street railway.

"The Executive" was responded to by Bro. Hunt, Executive President, who said that while at one time the fate of the Association seemed to hang by a slender thread, it was now on a satisfactory and progressive basis.

The Canadian Association of Stationary Engineers drew responses from representatives of various associations.

Bro. Wickens mentioned as an illustration of the growing importance of the engineers, that out of about 9,000,000 horsepower on the continent of America at present nearly three-quarters was the growth of the last ten years. The constant developments of machinery required the engineer to be studying all the time, and this was where the usefulness of an association came in.

Bro. York could say to young men that his knowledge of engineering had increased 100 per cent. since he became a member, and he could assure outsiders that their minds would never be narrowed nor their intelligence decreased by being in this Association. Young members should never be ashamed of asking questions, as it was by this means that knowledge was gained and new points brought out in discussion.

Mr. Drouin on behalf of St. Laurent No. 2, of Montreal, acknowledged the kind hospitality extended to him, and regretted that his limited knowledge of English did not enable him to speak at greater length.

Bro. Shapland, of London, Bro. Green, of Guelph, Bro. King, of Dresden, and Bro. King, of Kingston, also responded, giving encouraging accounts of the work being done by their Associations.

Bro. A. E. Edkins, replying to the toast "The Ontario Association of Stationary Engineers," sought to remove the misconception that the Ontario Association was an organization entirely separate from the C.A.S.E. and proceeded to explain the objects of the bill passed by the Ontario Legislatute under which the O. A. S. E. was formed. In Quebec, they now had a government licensing law which is compulsory and no doubt that law would be the means of raising the standard of qualifications of engineers in that province. If Ontario would pass an act under which the government would issue certificates, they would be willing to let the Ontario Associatition lapse in its favor.

The Executive Secretary, Bro. York, then read the following reply to the address of welcome presented by Toronto No. 1:

E. J. Philip, President, Toronto No. 1.

DEAR SIR AND BROTHER,—We, as a committee appointed by the 1894 Convention of Canadian Association of Stationary Engineers, on behalf of that convention, tender to you, as representative officer of Toronto No. 1, our cordial thanks for your hearty welcome extended to this convention. And also their very great appreciation of the efforts of your entertainment committee in providing a programme for the entertainment and amusement of this convention—a programme which has certainly never been equalled and could hardly be surpassed. On behalf of the convention, we trust they will accept our sincere thanks.

Committee—Thomas Ryan, William Jamieson, Robert King.

At intervals during the evening a number of excellent sentimental and comic songe were rendered bg Messrs. Geo. Grant, James Fax, John Alexander, and W. G. Blackgrove to whom a hearty vote of thanks was tendered.

THIRD DAY.

Thursday was pleasantly and profitably spent at Niagara Falls, under the direction of the following Committee:—Bros. A. E. Edkins, E. J. Philip, Wilson Phillips, W. L. Outhwaite, J. Fox, Wilford Phillips, J. C. McLachlan, J. G. Bain, W. G. Blackgrove, W. Bell, with A. M. Wickens as chairman, H. E. Terry, secretary, and Geo. Fowler, treasurer. The trip was made on the steamer Chippewa and over the Niagara Falls Park and River Railway. The power canal of the Cataract Construction Co., was inspected under direction of the engineer in charge, Mr. DeCourcey May.

On the Canadian side the power stations of the Niagara Falls Park and River Railway Co. were also visited and inspected under the guidance of Mr. Ross Mackenzie, the manager, J. C. Rothery, Assistant Superintendent, and W. Phillips, Mechanical Superintendent.

FOURTH DAY.

The convention re-assembled for the completion of its business at 10 a.m. A report was handed in by the Committee on good of the order, advising against the adoption of the proposal to issue graded certificates to members. The report was adopted after some discussion.

The Committee on Constitution and By-Laws reported as follows:

1. Your committee recommend that Sec. I., Art. 5, be amended to read thus: "That it be constitutional hereafter to have the nomination of candidates for office on the executive council precede the election of said officers, and may be taken up at any time after the opening of the annual convention, providing notice thereof has been given."

2. Your committee recommend that a new section be added to Article II., to be known as section 2, whereby subordinate associations shall issue to any member in good standing a withdrawal card, which, upon presentation thereof, shall entitle the holder to the full privileges and membership in any other association in the locality to which he may remove without the payment of initiation fee, and that Article II., section 1, on the laws of subordinate associations, be so amended.

3. Your committee also recommend to this convention that the executive committee formulate some scheme of insurance and benefits for members; the executive to be instructed to draft such scheme, and that the secretary of this convention notify each of the subordinate associations of the same not later than two months previous to the annual convention next ensuing.

4. That Article IV., sec. 2, on the laws of subordinate associations, be corrected; also that sec. 2 of same article (which is omitted from one edition of the constitution) be inserted, and that Art. III., section 4, be amended by erasing all after the word "each," and inserting instead the words "semi-annual."

It is the opinion of your committee that the rule appointing district deputies be more closely adhered to, there being no need for provincial deputies. A certain number of district deputies should be appointed at each convention, such appointments to be made by vote of the convention.

The first paragraph was thrown out, as well as the second and third clauses. The fourth clause was adopted.

The appointment of deputies was declared to be the prerogative of the President.

The auditors reported having found the books and reports correct, and recommended a refund of $3.87½ to Kingston Association of per capita tax.

The receipts of the souvenir were reported by Bro. York to be $842.50, and the estimated profit $300; this profit to be applied to defraying the expenses of the present convention.

Ottawa was chosen as the place of next meeting.

The following are the officers elected for 1894-5:

President—John J. York, Montreal.
Vice-President—W. G. Blackgrove, Toronto (acclam.).
Secretary—James Devlin, Kingston (acclam.).
Treasurer—Duncan Robertson, Hamilton (acclam.).
Conductor—E. J. Philip, Toronto.
Doorkeeper—J. F. Cody, Wiarton.

Upon the installation of officers, the newly-elected president ap-appointed the following as district deputies:

For Quebec—O. E Granberg, Montreal.
For Ontario—A. E. Edkins, Toronto.
For Manitoba—Chas. C. Robertson, Winnipeg.

The proceedings were brought to a close with the presentation to Bro. Hunt of a jewel in recognition of his valuable services as President, followed by brief speeches from the newly-installed officers.

TO CENTRAL STATION MANAGERS

• • •

Are your working expenses too high..?
Don't you think you could effect a saving?

• • •

THE undersigned makes a Specialty of overhauling complete plants, steam or water power, railway or light, with the object of stopping little LEAKS and increasing earnings.

GEO. WHITE-FRASER, C.E.
Electrical Engineer
18 Imperial Loan Building - TORONTO.

THE TORONTO INDUSTRIAL EXHIBITION.

BELOW will be found particulars of some of the exhibits at the recent Toronto Industrial Exhibition in which the readers of the ELECTRICAL NEWS are likely to be most interested :—

The Ballard Storage Battery Co., of Toronto, made an interesting show of fans, worked on the storage system, as well as a surgeon's battery.

Robin & Sadler, of Montreal and Toronto, presented an attractive showing in the east end of the Machinery Hall, of samples of all kinds and sizes of leather belting, laces, belt dressing, &c.

Kay Electric Works, Hamilton, had a well arranged and instructive exhibit, showing a 20 H. P. dynamo—an exciter for the alternator which worked the welding and heating machines, and for heating iron in water.

The Canadian Mineral Wool Co., Ltd., of Toronto, presented neat compact samples of their asbestos goods, steam packings, cotton waste, gaskets, steam and boiler covering. The Company is now manufacturing its wool in Toronto, thus reducing the cost of its material.

The Dodge Wood Split Pulley Co., of Toronto, placed before prospective purchasers a large variety of their well known split pulleys; also for the transmission of power and for hoisting purposes their tallow laid manilla ropes. They have specially made a new pulley for dynamos and motors. All their pulleys were running at high speed and attracted a good amount of attention.

The Johnson Electric Co., of Toronto, exhibited four motors, driven by the Wheelock engine which furnished the motive power to light the Main Building. The Company also provided the incandescent lights by the National alternator, producing 1,000 lights—the machine making 1350 revolutions to the minute. They likewise showed nine motors from $\frac{1}{8}$ to 5 H. P., search light, &c.

Barber & Watson, of Meaford, Ont., had on exhibition one of Barber's Canadian Turbines, which is apparently easy to handle, quick to respond, steady and sturdy in motion. The firm also manufacture gearing, hangers, shafting, pulleys, saw mill machinery and machinery and castings of all kinds. They have had an experience in the above lines of trade extending over a period of 26 years.

The Bell Telephone Co., of Montreal and Toronto, had a fine exhibit, very tastily arranged, in the Main Building, showing, besides the usual full lines of every kind of electrical appliances, a new keyless fire alarm box and a fire alarm for hotels. The Company manufacture in their factory in Montreal all the various apparatus connected with telephone and electric work. They fitted up the police patrol system in Montreal.

William C. Wilson, of Toronto, had an attractive display in the Machinery Hall of all kinds of lubricating oils and grease, engine packing, belting, electric carbons, cotton waste, &c., also samples of ammonia oils—the latter being subjected to a very high cold test and being specially prepared for ice makers and brewers. Mr. Wilson's stand was well arranged and decorated with electric lights, which showed off his exhibit to advantage.

F. E. Dixon & Co., 70 King St. E., Toronto, showed samples of different kinds of belting—round belts, rubber belting, cotton and lace leather, belt studs, twisted raw hide belting, and their Goodyear welting. The firm supplied the 18-inch double belt which was driven by the 40 H. P. engine belonging to the Johnson Electric Co. to run part of their machinery, and during the time of the Exhibition it had been in nse it had not stretched.

The Wm. Hamilton Manufacturing Co., Ltd., Peterborough, Ont., had on view the "Boss Turbine Water Wheel," which they claim gives the highest percentage of useful effect for every cubic foot of water used. It is made in dry sand, having smooth, even surfaces. The improved water wheel governor made by this Company is claimed to be the most simple, durable and efficient in correcting rapidly any disturbed motion of machinery driven by water power.

The Northey Manufacturing Co., Ltd., of Toronto, exhibited in the Machinery Hall several of their well known pumping engines. The one that attracted most attention from those practically interested, was their Underwriters' Fire Pump, the dimensions of which were 14 x 7 x 12, giving a capacity of 500 gallons of water per minute—equal to 2. $1\frac{1}{8}$ inch smooth nozzle streams—the engine, to produce this result, was driven at the rate of 70 revolutions per minute. The Company also showed an independent condenser, capable of supplying the wants of any steam engine of 200 H. P.; a brewer's air pump, with automatic regulator, as well as several small duplex feed pumps.

The town council of Millbrook has appointed a deputation to inspect the lighting plants of various towns prior to purchasing the necessary plant to light the town.

The street railway of St. Thomas, Ont., is said to have been purchased by Mr. Henry Everett, of Cleveland, Ohio, who is also interested in the Toronto and Montreal street railways. It is reported to be the intention to convert the railway into an electric line next spring.

Rumors have been abroad during the last few weeks pointing to the sale by the Royal Electric Company of their manufacturing business. The General Electric Co., the Montreal Gas Co., and the Stanley Electric Co., of Pittsfield, Mass., have all been mentioned as among the probable purchasers. Senator Thibeaudeau, President of the Royal Electric Co., has stated that there is no truth in these rumors.

At the annnual meeting of shareholders of the G. N. W. Telegraph Co., held in Toronto on the 26th of September, the following gentlemen were re-elected as the Board of Directors and Officers of the Company for the ensuing year : H. P. Dwight, Toronto, president and general manager ; Adam Brown, Hamilton, vice-president ; Hugh N. Baird, James Hedley, A. S. Irving, W. C. Matthews, Toronto ; Richard Fuller, Hamilton ; Hon. William McDougall, Ottawa ; Charles A. Tinker, New York ; secretary, and auditor, George D. Perry ; treasurer, Arthur Cox.

SPARKS.

An incandescent lighting plant is being installed at Midland, Ont.

The construction of a new telegraph line from Rat Portage to Fort Francis, is talked of.

The Peterborough Electric Light Co. will, it is said, establish a lighting plant at Tweed, Ont.

The electric lighting plant at Kemptville, Ont., was recently purchased by Mr. J. J. Collins, of Ottawa.

An amalgamation has been consummated of the two electric lighting companies at Sydney, Cape Breton.

The Calgary Water Power Co. have lately installed and put in operation in that city, an arc lighting plant.

It is said to be the intention of the Bell Telephone Co., to extend their system throughout Southwestern Manitoba.

A joint stock company is said to be in process of formation at Windsor, Ont., to manufacture signals for electric railways.

The Waterloo Farmers' Alliance Telephone Co., after having been in business three years, have sold out to the Bell Telephone Co.

An electric railway is talked of to connect Galt via North Dumfries, New Dundee and Haysville, with New Hamburgh and Baden.

Mr. W. C. Harriston has purchased from Mr. H. G. Buck, the electric light plant and business at Norwood, Ont., and is erecting a new station.

The citizens of Summerside, P. E. I., have voted down the proposition that the council should purchase and operate an electric lighting plant.

Owing to some irregularity in the tenders submitted for an electric light plant for the town of Kincardine, the council decided to invite new tenders.

Messrs. F. H. Sleeper & Co., of Coaticook, Que., are endeavoring to form a company to supply electric light to the towns of Huntingdon and Ormstown.

Petitions are being circulated and signed at Ottawa, asking the council to request the Electric Railway Company to inaugurate a limited Sunday service.

Mr. T. S. Bell, Engineer, of Hamilton, has been employed to report on the possibilities of the water power at Chedoke Falls, for electric lighting purposes.

The Directors of the Hamilton & Dundas Railway Co. have decided to defer changing the line from steam to electricity, until July, 1896, when the Myles lease will have expired.

Mr. Gilbert Johnston, formerly chief engineer, and subsequently master of the steamer Hero, has recently been appointed chief engineer of the Richelieu & Ontario Navigation Co.

The Toronto Street Railway Co. carried 1,936.119 passengers during the recent Industrial Exhibition at Toronto, as compared with 1,797,877 during the same period of the preceding year.

The town of Trenton, Ont., has approved of a by-law to apportion $6,000 for the construction of a power house at the dam on the river north of the town, where it is proposed to generate electricity for lighting and manufacturing purposes.

The township council of York, at a meeting to be held on the 8th of October, will consider the advisability of passing a by-law to authorize the extension of the Toronto Suburban Railway Company's line to the village of Weston.

It is said to be the intention of the Montreal Park & Island Railway Co., to double track their line to Back River and to add six-hundred H. P. to their steam and electric plant. The Company have now under construction in the exhibition grounds, repair shops and car barns.

The ratepayers of the village of Weston have refused to sanction the proposed bonus of $5,000 to the Suburban Street Railway Co., to induce the company to extend their line to that village. Mr. Fraser, the Manager of the Company, states that unless the bonus is granted the extension will not be made.

Incorporation is being applied for by the Cataract Power Company, at Hamilton, for the purpose of conveying power to Hamilton from Niagara Falls. The promoters of the Company are, Messrs. W. H. Glassco, W. Southam, R. Fuller, W. A. Wood, J. W. Hendrie, W. W. Osborne, John Patterson.

After having sent a deputation to inspect the lighting stations of various towns and cities in Canada and the United States, the City Council of Stratford has instructed the fire and light committee of the Council to obtain plans and invite tenders for an electric light plant, to be owned and operated by the city.

The Yarmouth, N. S., Telephone Co. is reported to have earned a net profit on the past year's business of twenty-six per cent. Out of this a dividend of ten per cent. will be paid. The officers of the Company were re-elected as follows : President, H. B. Cann ; secretary, E. K. Spinney, and treasurer, J. M. Lawson.

The Montmorency Electric Power Co., of Quebec, have commenced the construction of a new brick and stone building, 95 x 45 feet in size, on Prince Edward Street, in St. Roch's. This building is to be used as a distributing station and for office purposes. It is expected that the Company's new plant will be installed and in operation before the close of the present month.

A handsome new car has been constructed at the General Electric Company's works at Peterboro, for the Kingston Electric Railway Co. The car will be used for special occasions only. It is said that the company will make a new departure by placing this car at the disposal of those who wish to attend the opera, etc , in full dress, and who are willing to pay for extra accommodation.

The town of Magog, Que., has entered into a contract with Mr. LeMay to supply arc and incandescent lights for a period of five years. The price for arc lights is $55.00 per year ; for sixteen candle power incandescent lamps, $5.00 ; and for 32 c. p. lamps, $10.00. A condition of the contract is that 16 c. p. lights are to be furnished to citizens requiring them at a price not to exceed $6.00 per lamp per year.

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TRADE NOTES.

Messrs. F. H. Sleeper & Co., of Coaticooke, Que., are installing an electric light plant in the Dominion Snath Co.'s factory, at Waterville, Que.

The St. John Gas Light Co., St. John, N. B., have placed an order for a 2500 light alternating incandescent plant with Messrs. Ahearn & Soper, of Ottawa.

The 2500 light plant purchased from Messrs. Ahearn & Soper, of Ottawa, by the Windsor Electric Light & Power Co., of Windsor, N. S., has been put in operation. The lights are being taken up very rapidly.

The Chambers Electric Light & Power Co., Truro, N. S. are adding to their plant a 90 horse power Robb-Armstrong engine. This makes three of these engines purchased by them during the past two years.

The two electric light companies in Sydney, C. B. have amalgamated, and are increasing their plant by the addition of a 90 horse power Robb-Armstrong engine, and a 90 horse power Monarch Economic boiler.

Among recent shipments by the Robb Engineering Co., Amherst, N. S. are a 40 horse power Robb-Armstrong engine, a 40 horse-power Monarch boiler and a Perfection rotary saw mill to Messrs. John E. & G. Lake, Fortune Bay, Newfoundland.

The contract for the cars and electrical equipment of the St. John, N. B., Railway, has been placed with Messrs. Ahearn & Soper, of Ottawa, who will furnish twelve vestibuled cars with an outfit of two 30 h. p. motors each, of the Westinghouse type. The station equipment consists of two 250 h. p. generators of the Westinghouse multipolar type.

Messrs. Ahearn & Soper, of Ottawa, are very busy with orders for electric railway and electric light apparatus, and their Car Works are turning out large numbers of cars. The latest shipment consisted of twelve cars of various types to the Hamilton, Grimsby & Beamsville Electric Railway Co., and the factory is now at work on a number for Montreal and St. John, N. B.

SPARKS.

A twelve year old son of Mr. John F. Baker, of Kingston, is said to have prepared plans for an engine, and to have made the parts, put them together, and started the machine in successful operation. It is said to be the lad's intention to take a course in electrical engineering at Queen's University.

It is reported that the city of Hamilton will be asked to vote a bonus of $125,000 to aid the construction of the Hamilton, Waterdown and Guelph Electric Railway. The balance of the amount required to build the road is said to have already been subscribed. The total cost of the enterprise is placed at $300,000.

At a meeting of the City Council, of Hull, Que., held last week, an electrfc railway and lighting franchise was granted to Theophile Viau, and a company will be formed at once to construct and operate the works. The railway scheme will probably embrace branches to Aylmer, nine miles; Gatineau, four miles, and Ironside, five miles.

The Gas Company, of Galt, Ont., have ordered an electric light plant from the Canadian General Electric Co., of Toronto.

The Bell Telephone Co. has purchased property at the southwest corner of Notre Dame and St. John streets, Montreal, and will commence work at once on the erection of a new building suitable for their purposes.

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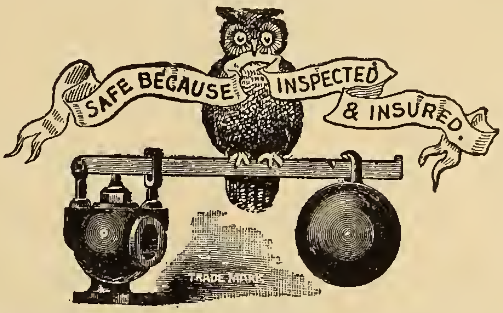

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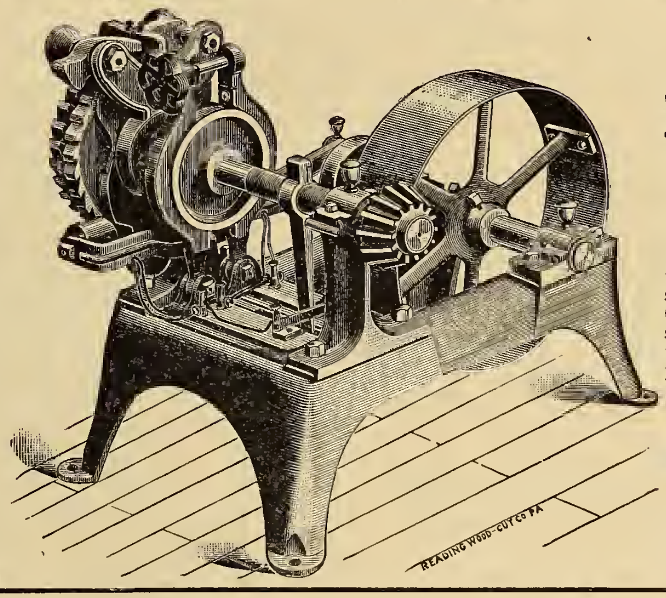

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MOONLIGHT SCHEDULE FOR OCTOBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	
1......	P. M. 6.20	A. M. 5.10	10.50
2......	" 6.20	" 5.10	10.50
3......	" 7.30	" 5.10	9.40
4......	" 8.20	" 5.20	9.00
5......	" 9.20	" 5.20	8.00
6......	" 10.10	" 5.20	7.10
7......	" 11.00	" 5.20	6.20
8	" 11.30	....	5.50
9......	....	" 5.20	
10......	A. M. 12.40	" 5.20	4.40
11......	" 1.50	" 5.30	3.40
12......	" 3.00	" 5.30	2.30
13......	No light.	No light.	....
14......	No light.	No light.	....
15......	No light.	No light.	....
16......	P. M. 6.00	P. M. 7.40	1.40
17......	" 6.00	" 8.20	2.20
18......	" 6.00	" 9.10	3.10
19......	" 6.00	" 10.10	4.10
20	" 6.00	" 11.00	5.00
21......	" 5.50	" 12.00	6.10
22......	" 5.50	A. M. 1.00	7.10
23......	" 5.50	" 1.10	7.20
24......	" 5.50	" 2.20	8.30
25......	" 5.50	" 3.20	9.30
26......	" 5.50	" 4.30	10.40
27......	" 5.50	" 5.50	12.00
28......	" 5.40	" 5.50	12.10
29......	" 5.40	" 5.50	12.10
30......	" 5.40	" 5.50	12.10
31......	" 5.40	" 5.50	12.10
		Total,	204.50

Incorporation is being applied for by the London Electric Co., London, Ont., to manufacture electricity for commercial purposes in that city. The proposed capital stock is $250,000. Among the applicants are Messrs. W. R. Brock, H. P. Dwight, Frederic Nicholls, Geo. A. Cox, Hugh Ryan, Robert Jaffray, and J. J. Kerr, all of Toronto, and M. J. Kent, C. B. Hunt, Edmund Meredith and C. R. Cameron, all of London.

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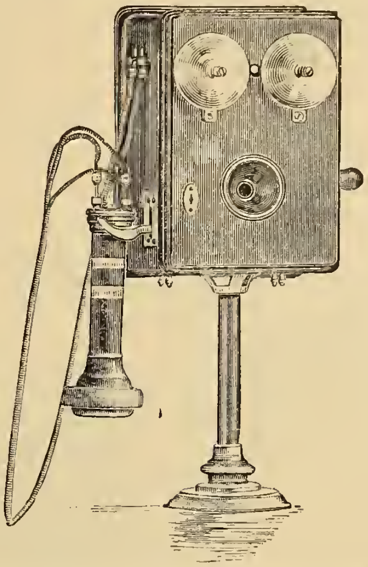
Catalogues will be furnished on application.



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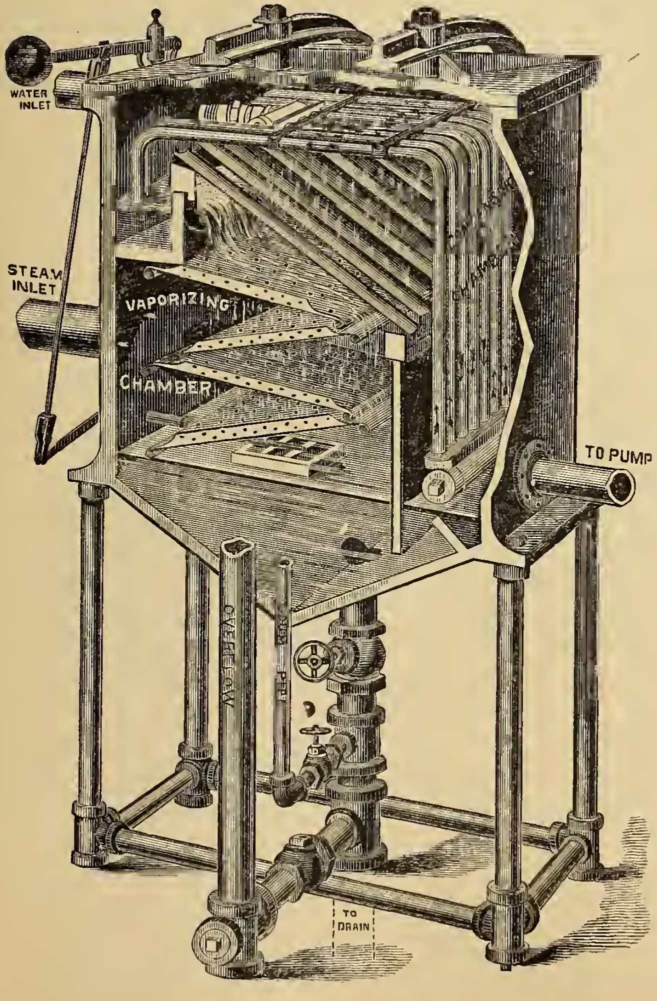

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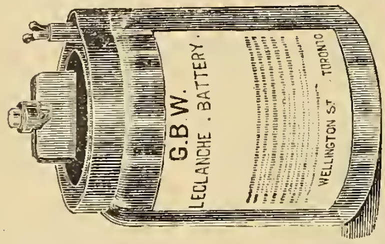

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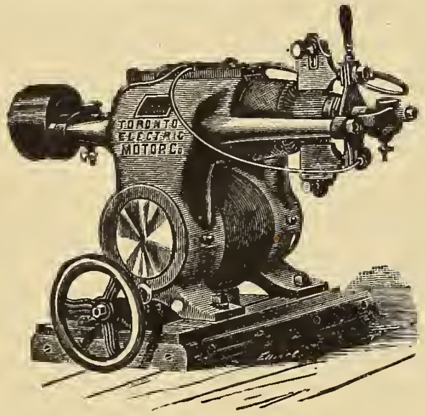

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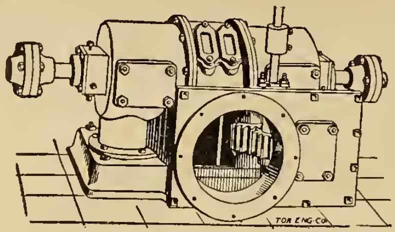

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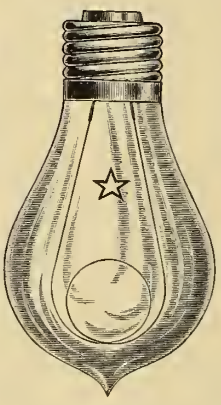

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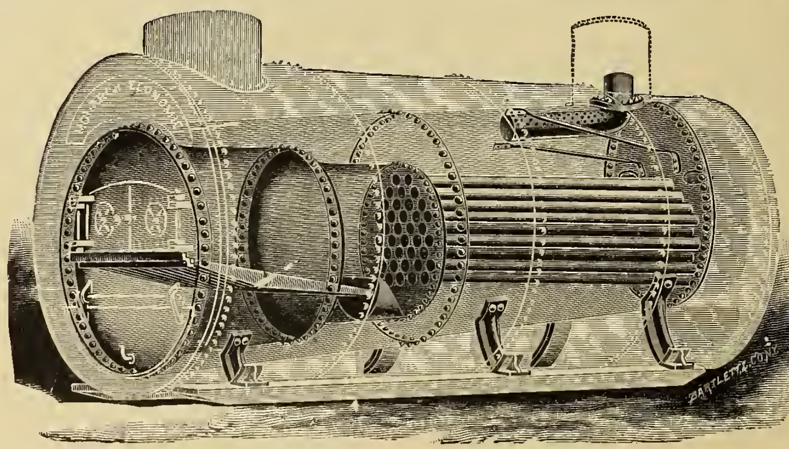

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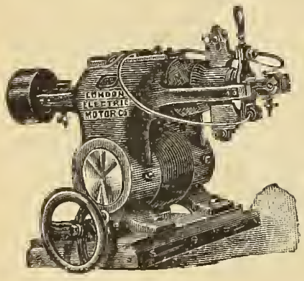

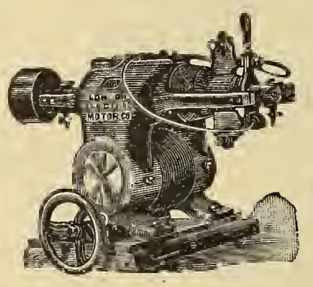

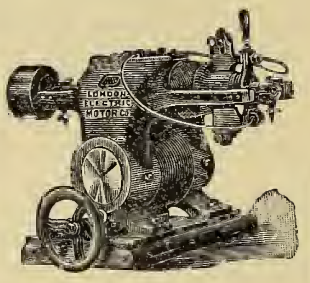

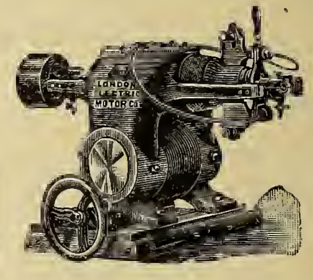

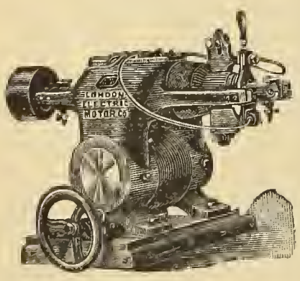

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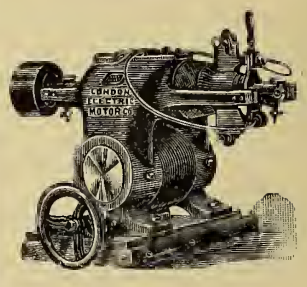

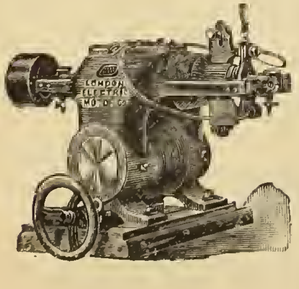

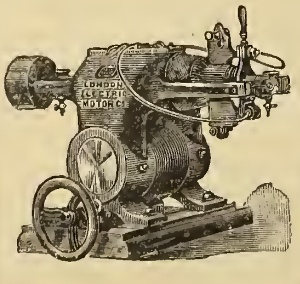

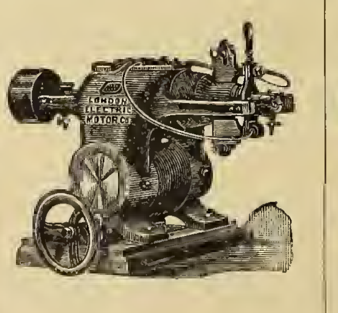

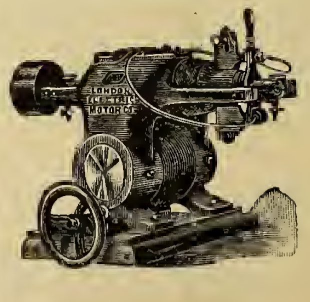

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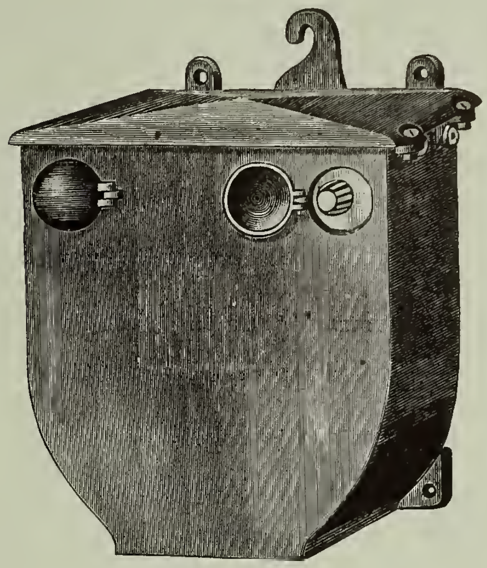

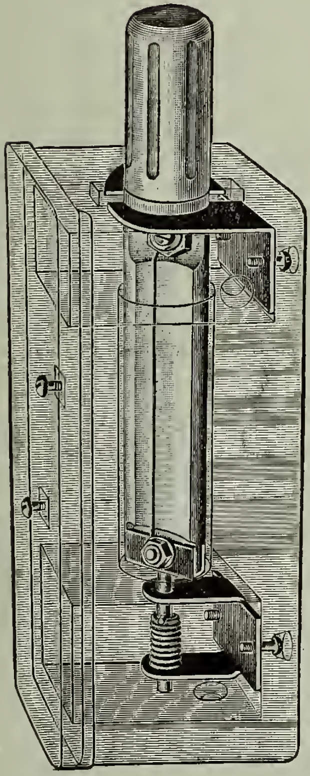

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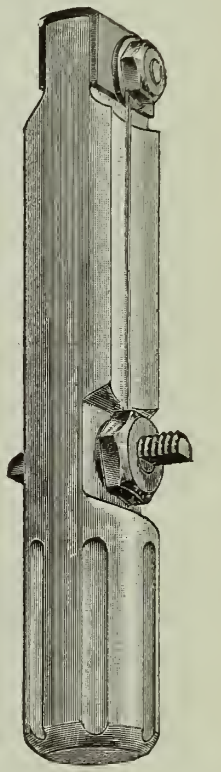

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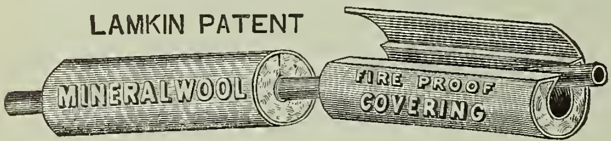

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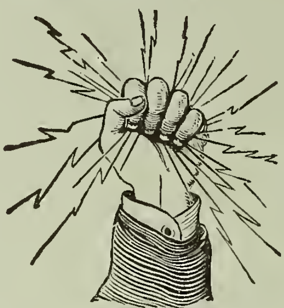

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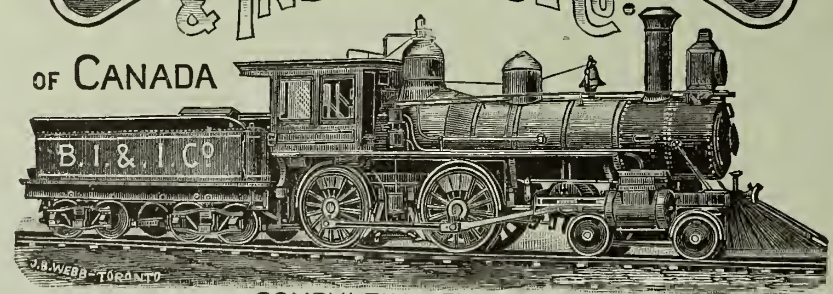

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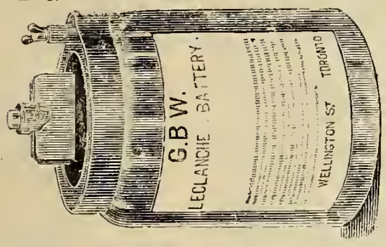

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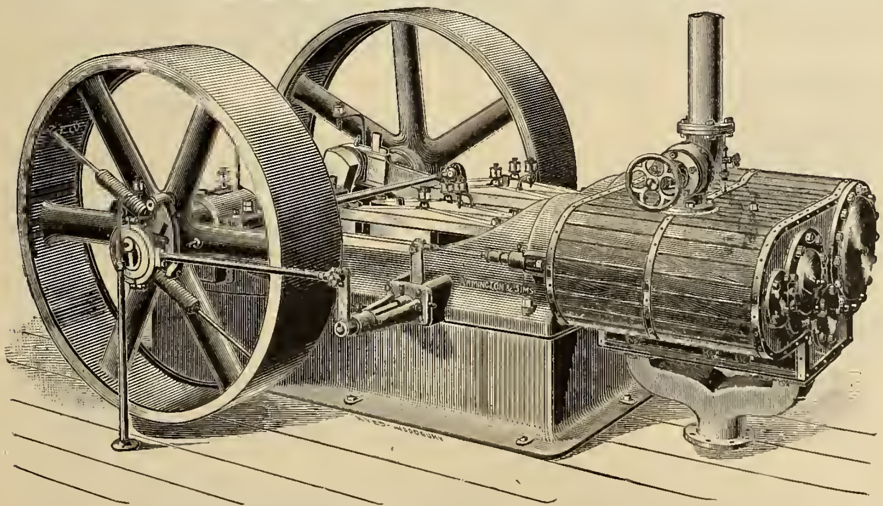

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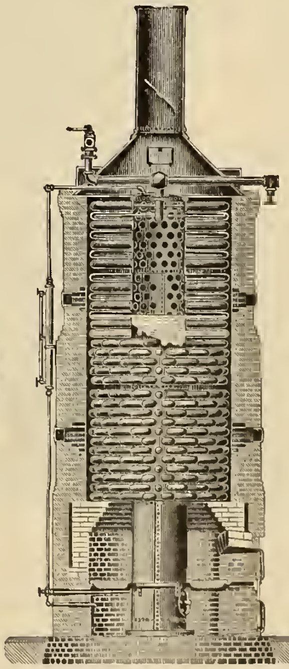

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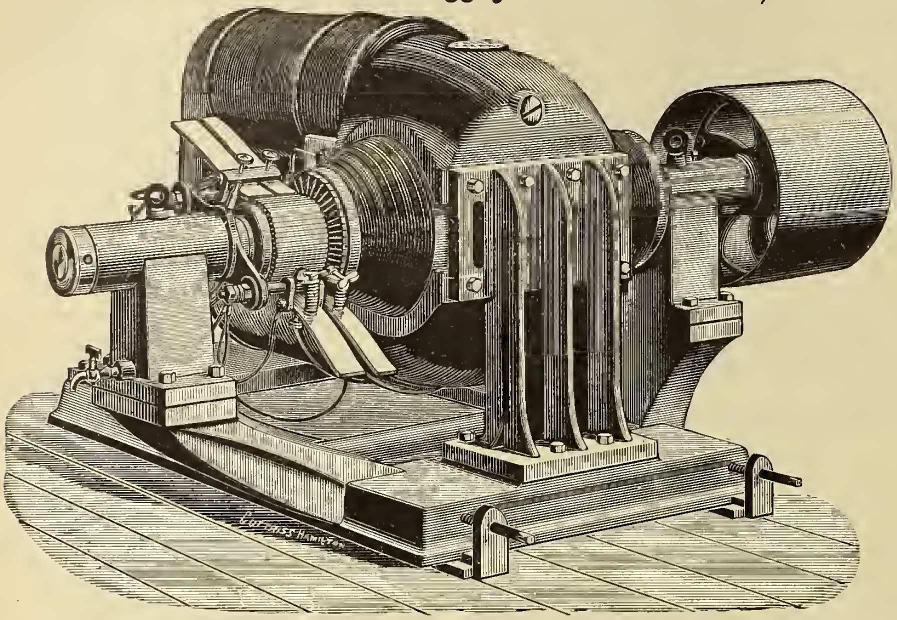

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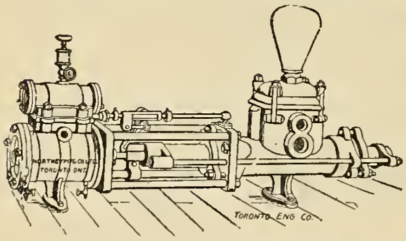
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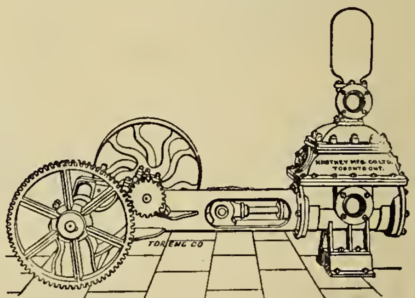
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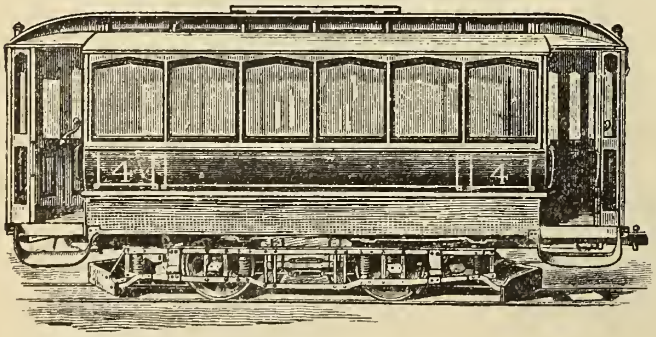

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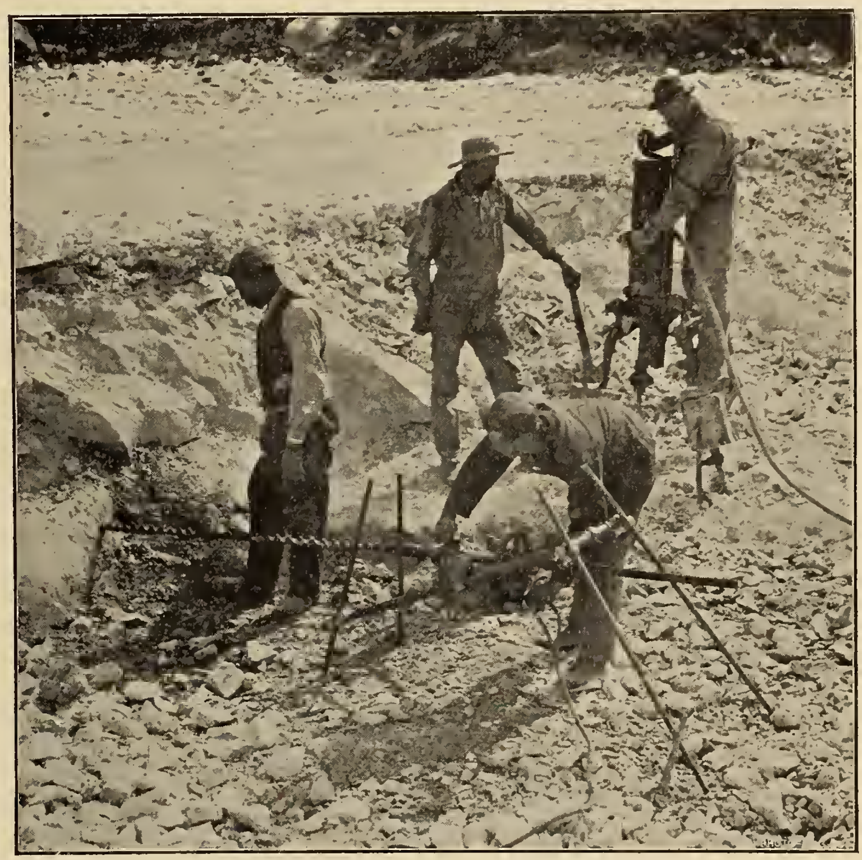
VOL. IV. NOVEMBER, 1894 NO. 11.

ELECTRIC PERCUSSION AND ROTARY DRILLS.

THE accompanying illustration shows in operation at the Windsor Gypsum Quarries, Windsor, Nova Scotia, portable electric percussion and rotary drills which have lately been introduced and are being manufactured by the Canadian General Electric Co.

The percussion drill in general external appearance conforms very closely to the regular type of steam and air drill; in fact the tripod and shelf are of the standard steam drill form. Electrically, it is arranged in the form of a solid piston reciprocating in a magnetic field and controlled thereby. The piston is provided with a standard air drill rotating rifle-bar and the usual form of springs to protect the front head of the drill from blows. The drill has a piston diameter of 3¾", a length of stroke from 6½" to 8½", length of feed 24", number of blows per minute, 360 to 380.


ELECTRIC PERCUSSION AND ROTARY DRILLS,
IN OPERATION AT THE WINDSOR GYPSUM CO.S QUARRIES, WINDSOR, N. S.

The first of these drills was installed on the Canadian "Soo" Canal last winter, when the contractors, Messrs. Hugh Ryan &Co., were greatly pleased with its performance. On these works the performance was equal to that of a 3" steam drill, and the facility with which the drill could be moved, owing to the complete flexibility of the connections, was especially remarked. As far as economy goes, it far surpassed any other drills on the works. The cost of operating, including power for operating the generator and labor of the attendant at the power house, was somewhat under the average operating expenses of the steam drills. Bearing in mind that the attendance at the power house is the same whether one drill or fifty are in operation, and that the increase of power is by no means in proportion to the number of drills, it will be readily seen that a very great saving will be effected over steam drills where the number in operation is the same.

In the Windsor Gypsum Quarries, Windsor, N. S., where one of these drills is in operation, every satisaction is being given by it. The best day's work of one drill on record is ten 10 ft. holes in 9 hours and 20 minutes. This was in glow lime stone.

The rotary drill is designed especially for use in coal mining, but has also been used with great success in the Gypsum Quarries of the Windsor Gypsum Co., where the clayey nature of the material tends to clog the drill and imposes the severest test on the capability of the machine. The drill is similar to the well-known Howell's drill with an electric motor geared to it in such a way as to form a light and efficient tool. The control of the motor is effected by a small plug switch. No rheotsat being used, power may be taken from the same wire supplying current for lighting, pumping or haulage.

Feed screws of different pitch are furnished for varying the speed of boring and a friction clutch protects the motor should any particularly hard obstacles be struck suddenly.

The columns are made in different lengths and each is adjustable for about two feet variation. The construction of the drill and its method of mounting enable the operator to drill close to the roof, floors or walls as well as in any direction.

The drill weighs with post complete only about 160 lbs., the drill itself weighing 100 lbs. In bituminous coal this drill shows a speed of drilling of 7 to 10 feet per minute.

WHAT ZERO MEANS.

The word zero is from the Spanish and means empty, hence nothing. It was first used on a thermometer in 1707 by a young Prussian named Gabric Fahrenheit, then but 19 years of age. From a very small boy he had been a close observer of nature, and in the years mentioned above, while experimenting by putting snow and salt together, found that it produced a degree of cold equal to the coldest day in the year. The young discoverer was struck with the coincidence of his little scientific discovery, and hastily concluded that he had found the lowest degree of temperature known in the world, either natural or artificial.

The Carriage World adds that he called the degree "zero," and constructed a thermometer, or rude weather glass, with a scale graduated up from zero to boiling point, which he numbered 212, and the freezing point 32, because as he thought, the mercury contracted the 32nd of its volume on being cooled down from temperature of freezing water to zero, and expanded to the one hundred and eightieth part on being heated from the freezing to the boiling point.

Time showed that this arrangement, instead of being truly scientific, was as arbitrary as the division of the Bible into verses and chapters. Fahrenheit's thermometer became widely adopted before any one adopted a better scale, and those who now use it cling to it as Englishmen cling to their difficult and cumbersome fractional money. The three countries which use Fahrenheit's scale are England, Holland and America. Russia and Germany use Baumer's, in which the boiling point is counted 80 above freezing, zero. France uses the centigrade, so called because it makes the boiling point 100 degrees from the freezing point.

The town council of Lachine, Que., will ask Mr. R. Bickderdike to renounce his right to construct an electric road from Montreal to that place, in order that the council may be in a position to accept the offer of the Montreal Park & Island Railway Co., to begin at once the construction of such a road.

A Toronto syndicate, at the head of which is said to be Mr. Alex. Manning, announces that it has purchased the Drummondville street railway, which it is proposed to transform into an electric road, with terminals at Niagara and Chippewa. The promoters of the company have made application to the town council of Niagara Falls for a bonus of $75,000 to aid in the transformation and extension of the line.

REPORT ON DUTY AND CAPACITY TRIAL OF WORTHINGTON PUMPING ENGINE AT LOW LEVEL PUMPING STATION, MONTREAL WATER WORKS.

BY PROFESSOR J. T. NICOLSON, B.SC., AND J. EMILE VANIER, C.E.

THE following report was recently presented by Messrs. Nicolson and Vanier to the Water Committee of the City of Montreal :—

Acting under your instructions, we have conducted duty and capacity trials of the new ten million gallon high duty Worthington Pumping Engine, recently installed at the Low Level Pumping Station, and have the honor to report as follows :

According to the contract, the engine must be capable of pumping at the rate of ten millions of Imperial gallons of water in 24 hours, against a difference of pressure in suction and force mains of not exceeding 80 lbs. per square inch ; and it must be able to perform a duty of one hundred and five million foot pounds of work for every hundred pounds of coal burnt.

In lieu of the latter stipulation, your experts agreed to accept a performance of one hundred and five million foot pounds of work for every thousand pounds of feed water supplied by the boilers, it being understood that the steam used by the feed pump should be counted against the manufacturers.

The engine is of the latest type of horizontal Worthington High Duty Pumping Engine, having cylinders arranged on the double tandem compound direct acting principle. The general features of construction are shown in the accompanying cuts.

The steam cylinders are all jacketed, both on sides and ends, with steam of boiler pressure, and reheaters are provided, through which the steam passes on its way from the high to the low cylinders, which are likewise steam-jacketed. The steam which is used in the jackets is that derived from the drain pipe of the separator, which belongs to the engine, and the steam from this point passes in succession through the reheaters, which are at the highest elevation, and thence through the jackets of the four cylinders, finally being delivered into a common drain pipe, which proceeds to a tank in which the water of condensation is collected. The jacket tank is drained by a small duplex steam pump, working automatically, the throttle valve being under the control of a float in the tank, and this water is pumped into the boilers. The size of the pump is 3 x 2 x 3 inches. The pipe leading from the pump to the boilers is independent of any other feed pipe. The exhaust steam discharged from this pump is carried to the hot well in the basement of the engine house, which serves for the supply of water to the boilers, being itself supplied by the overflow water discharged from the air pumps of the engine. The hot well tank is one which has formerly served the same purpose for the old engines in the pumping station. Its diameter is 24 inches, and its length 13 feet.

In addition to the jacket pump, there is a second steam pump connected with the engine, which, by means of a set of pistons, furnishes air to the top of the accumulator cylinder, and, by means of a set of plungers, furnishes water to the under side of the accumulator ram. The size of the pump, which is of the duplex type, is 4½ x 3 x 4 inches. The exhaust steam from this pump, like that from the jacket pump, is carried to the hot-well tank just referred to. This is an auxiliary piece of apparatus, as the pressure on the ram is usually kept up by a pipe supplied from the force main. The air pumps of the condensing apparatus are operated by direct connection with the main engine, the only accessories about the engine itself which consume steam, are the jackets and the two direct-acting steam pumps referred to.

The feed pump, for supplying the boilers with water, is one which has already been in use for the old plant. It is located in the cellar, under the engine room, near by the hot well tank. The exhaust steam from this pump is carried into the tank. Its size is 6 x 4 x 6 inches duplex.

The cylinders are protected from radiation by a covering of asbestos, outside of which is a layer of hair felting, and the whole is encased in black walnut lagging. The steam pipe, extending the whole distance from the boilers to the engine, is covered with magnesia, and that part within the engine-room is finished with black walnut lagging.

DIMENSIONS OF ENGINE.

Diameter of each of two high-pressure cylinders........	25 inches.
Diameter of piston rods of same	5¼ inches.
Net area of high-pressure cylinders....................	469.11 sq. inches.
Diameter of each of two low-pressure cylinders	50 inches.
Diameter of piston rods of same	5 inches.
Net area of low-pressure cylinders	1953.68 sq. inches.
Maximum stroke of steam pistons........................	38 inches.
Diameter of each of two plungers.......................	27⅝ inches.
Diameter of plunger rods...............................	5¼ and 3½ ins.
Net area of plungers...................................	583.74 sq. inches.
Average length of stroke during trial	3.157 feet.
Diameter of two double-acting air pumps....	12 inches.
Stroke of same...	3.157 feet.
Diameter and stroke of feed pump piston..............	6 inches.
Diameter of plunger of same.......................... ..	4 inches.
Diameter and stroke of jacket pump....................	3 inches.
Diameter of plunger of same............................	2 inches.
Vertical distance between centres of suction and force main gauges............	10.66 feet.

TRIALS.

The engine was run for 55.33 hours at its full power without intermission. It worked smoothly and well, without undue heating of any part, or leakage of any kind. This run began at 10.40 a.m. on Friday, July 27th. On that day the temperature test was made, all the conditions of operation being retained in the proper normal state for the purpose of observing the temperatures of the various supplies of feed water to the boilers. On the 28th, the duty and capacity trial lasting 10 hours was made, the feed water being supplied through suitable tanks and weighed the jackets, reheaters and separator drain being also caught and weighed. At 7.22 p.m. on Saturday the trial ended, and the engine was stopped at 6 p.m. on Sunday, the 29th.

During the temperature test, the feed pump (made by Snow) exhaust was led into the hot well ; the jacket pump was not worked, but the jacket tank drained into measuring tanks, its temperature being obtained before the pressure fell ; the temperature of the main feed was observed close to the boilers. Readings were made every fifteen minutes of the steam pressure and vacuum gauges of the gauge on the force main, of the mercury column on the suction main, of the number and length of the strokes of each engine ; in order that the engines might be kept working in exactly the state in which they would perform their rated duty and capacity.

The duty and capacity trial began by a signal given when the height of water in the three boilers and in the feed tank had been simultaneously noted ; the readings of the two counters in the engine being then read. At the same time the jacket tank drain was diverted, being caught and weighed throughout the trial. The main feed pump received steam from the same boilers as supplied the main engine, and was reckoned as part of the steam used by it. It exhausted to waste. The amount of steam used by feed pump was ascertained by condensing its exhaust on a subsequent day. Twelve indicators were used on the trial, eight Crosby indicators on the four steam cylinders, and two Tabors, and two Thompson's on the two pump chambers

Indicator cards were taken every hour, of which average specimens are presented below. The readings made every fifteen minutes included :—Temperatures of engine room, jacket drain, pressure of steam, vacuum and water gauges, mercury column, engine registers and boiler gauges, and the lengths of ten successive strokes of each pump. The dryness of the steam was tested for one hour at a time, by three independent tests. The instrument used was a Peabody Throttling Calorimeter, which was attached to the main steam pipe just before the separator. The separator drain was estimated by means of the Calorimeter, the assumption being that all the wetness in the steam was left in the separator.

This trial ended nine hours and 46 minutes after its commencement, by a signal given in the engine room, when the boilers had been filled up to the same heights as at the beginning of the test, when the engine registers were again read. The feed tank was then filled to the hook gauge used at the commencement, and the feed and jacket drain sheets closed. A counter on the feed pump enabled the number of strokes made by it during the trial to be recorded. The exhaust from it was subsequently condensed and weighed, when working at the same rate of speed. The pressure against which the plungers worked being 4.57 lbs. in excess of the stipulated 80 lbs., it was mutually agreed to by your experts and Messrs. Worthingtons' representative, that the steam pressure on the boilers would be 105 lbs. instead of 110 lbs. Acting upon instructions, the stokers accordingly kept the pressure between 104 and 106 lbs. on the boiler gauges during the whole trial.

All gauges, indicator springs and weigh scales were tested and calibrated by the standards at McGill College, before and after the trial.

The assistants employed on the part of your experts upon the trials were : Mr. G. Sinclair Smith, B.A., Sc., Demonstrator of Thermodynamics, McGill College ; Mr. J. S. Costigan, B.A., Sc.; Mr. Leonard Dyer, B.A., Sc.; Mr. Archd. Duff, B.A., Sc.; Mr. Robins ; Mr. Hutchinson, and Mr. Laurin, C.E., Chief Assistant in Mr. Vanier's office.

DATA CALCULATIONS.

The following are the principal data obtained from the trials, and the calculations based threupon :

Duration of test......... ....9 hrs., 46 mins. =	9.77 hrs.
Average pressure by boiler gauges (corrected)................	104.8 lbs.
" " " " absolute........	119 6 "
" " engine gauges (corrected)	103.35 "
" " " " absolute.	118.15 "
Average pressure in steam pipe at the throttle valve (abs.)	119.0 "
" " barometer..............................	14.8 "
" temperature of main feed..........................	155°.62 F.
" " of jacket tank drain..............	330°.4 F.
Total weight of water measured into boilers................	740.79 lbs.
Weight of water drained from separator jackets and reheaters.	8228.5 "
Weight of steam lost by Calorimeter tests....................	360.0 "
" " supplied to engine and feed pumps	737.19 "
" water drained from separator (73719 x .006).......	442.3 "
Dryness fraction of steam supplied	99.4%

Absolute pressure in steam pipe..............	119 lbs.
Heat of water at temperature, 340°.42 F..................	311.4 T. U.
Latent heat of steam at 119 lbs., abs........................	874.4 T. U.
Absolute pressure in Calorimeter..............................	30.9 lbs.
Temperature corresponding to same...........................	252°.0 F.
Actual temperature in Calorimeter...........................	298°.0 F.
Total heat of steam at pressure 30.9 lbs.	1158.4 T. U.

$$\text{Dryness fraction}: \; x=\frac{1158.4-311.9+.48\,(298-252)}{874.4.}=0.994.$$

MEAN EFFECTIVE PRESSURES.

North Engine :—

High pressure, east end.........	41.10 lbs.
" " west end...... ..	42.18 "
Low pressure, east end..........	16.52 "
" " west end.........	16 88 "
Pump, east end	85.43 "
" west end................	85.75 "

South Engine :—

High pressure, east end.........	45.45 lbs.
" " west end.........	43.30 "
Low pressure, east end.........	15.45 "
" " west end.........	17.44 "
Pump, east end	85.28 "
" west end................	85.68 "

HORSE POWER.

North Engine..	229.05 H.P.
South Engine	233.45 "
Total..................................	462.50 H.P.

Horse power of pump (obtained from cards)........	438.97
Mechanical efficiency..	94.9%
Number of strokes in 9 hrs., 46 mins	53,840
Average length of stroke....................................	3.157 ft.
Piston speed during trial (feet per minute)..................	145 02

PRESSURES IN PUMP

Average pressure per sq. in. on force main gauge	76.75 lbs.
" " " in suction main (mercury column)...	3.21 "
Pressure due to difference of height of gauges.................	4.61 "
Total mean average effective pressure against plungers.	84.57

WORK OF PUMP.

Work done by plungers in 9.77 hours,

84.57 x 583.74 x 53840 x 3.157= 8,392,600,000 ft. lbs.

Steam used in performing this work............	73,277 lbs.
Duty per 1000 lbs. of feed supplied.................	114,532,000 ft. lbs.

CAPACITY IN 24 HOURS.

At 145 ft. piston speed,

$$\frac{3.157\times 583.74\times 53840\times 24\times 6.2322}{144\times 9.77}=10{,}524{,}300 \text{ Imp. gals.}$$

At 142 ft. per min. piston speed as per contract..... 10,306,500 Imp. gals.

DUTY PER 1,000,000 THERMAL UNITS.

Total heat above 32° F. of steam at 119 lbs., abs.	1185.8	T. U.
Heat of water at 155°. 62 F.	123.8	''
Heat received by engine per lb. of main steam	1062.0	''
Heat in water at 330°. 4 F.	301.0	''
Heat received by engine per lb. of jacket steam	884.8	''
Heat in water at temp. of 119 lb. steam	311.4	''
" " " 330°. 4 F.	301.0	''
Heat received by engine, per lb. of separator drain	10.4	''

HEAT RECEIVED DURING 9.77 HOURS BY ENGINE.

From main steam, 65490.5 × 10620=69,550,000 T. W.		
" jacket and reheater steam ....7786.2 × 884.8=	6,889,250	T. U.
" separator steam	4,600	"
Total	76,443,850	"
Duty per 1,000,000 Thermal units	109,785,000	ft. lbs.

FEED PUMP.

Feed water used by feed pump in 9.77 hrs.	1,099 lbs.
Horse power of feed pump	0.938 H. P.
Steam used by feed pump per horse power hour	119.8 lbs.

CONCLUSION.

It appears from the results of the trial made by your experts that the engine performed a duty of more than one hundred and fourteen million foot pounds for every one thousand pounds of feed water supplied to it. If it be assumed that one thousand pounds of steam at a pressure of one hundred pounds per square inch are equivalent to one hundred pounds of coal (an estimate your experts were willing to accede to, although Messrs. Worthington were thereby relieved from making good the performance of the boilers, which by the letter of the contract they were bound to do) then the engine has exceeded its contract duty by 9 million foot pounds. If only nine hundred and fifty pounds of steam be allowed per hundred pounds of coal (an evaporation which is easily obtainable with ordinary boilers) then the engine shows a duty of 108 million foot pounds per 100 lbs. of coal.

On the score of duty the manufacturers in the operation of this engine have therefore abundantly fulfilled the stipulation of the contract.

The engine showed a capacity, when on trial and working at 2% over the piston speed allowed by the contract, of 10,524,000 Imperial gallons. Its capacity at the limited piston speed allowed by the contract is therefore 10,306.500 Imperial gallons in twenty-four hours, a quantity about 3°/o in excess of that which is required by contract, so that in this respect also the contractors have exceeded their guaranteed performance.

The materials and workmanship throughout of the engine have been examined by your experts and are found to be of a high quality, the design being of a substantial character and the bearing surfaces ample.

Throughout the trial the engine ran smoothly and well, even although working somewhat beyond its normal duty and capacity, and the consumption of oil did not appear to exceed a warrantable amount.

Your experts have therefore decided to recommend the engine for acceptance by the Water Committee of the Council of the City of Montreal, and they hereby recommend the same for acceptance.

Your experts have the honor to be,

Your obedient servants,
(Signed) JOHN T. NICOLSON,
(Signed) J. EMILE VANIER.

A CORRECTION.

THE following letter has been received from Mr. Chas. F. Medbury, of Ottawa, with reference to the equation presented by him at the Montreal convention of the Canadian Electrical Association for determining the distance at which the cost of transmitting any given power electrically by high or low voltage is equal, and which was printed in the convention proceedings in the ELECTRICAL NEWS for October :—

"Owing to my absence from town I was not able to go over the type written copy of data which was sent to you from this office and therefore did not have the opportunity to make any corrections. I notice that through a typographical error in the last equation giving the weight of copper, it reads, 'c is equal to

$$3950.5 \frac{a \quad d}{\text{volts lost.'}}$$

This should be d^2 instead of d, which, as you will see, makes quite a difference in the value of the equation. Moreover, following this equation, it should read: 'where a is the amperes on the line and d is the distance under consideration.' Otherwise, I believe it is correct.

Yours truly,
CHAS. F. MEDBURY."

QUESTIONS AND ANSWERS.

W. S. D., Halifax, Nova Scotia, writes: I would very much like to have your opinion on the following if you care to give it. We have a Knowles jet condenser for using salt water. Water cylinder is 14″ × 14″. Do you think it is large enough to condense for 300 H. P.? The exhaust opening is 8″, injection 5″.

ANS.—Assuming that 30 lbs. of water per H. P. per hour are required, 300 × 30 equals 9000 lbs. per hour ; and as there are 10 lbs. of water contained in each gallon, then 9,000 divided by 10, equals 900 gallons per hour. It is usually conceded that for every gallon of water used by the engine, 30 gallons of injection water are required for the condenser, so that 900 × 30 equals 27,000 gallons required per hour. Your water cylinder is 14″ diameter, and has an area of 153.9 square inches ; and for every foot of its travel it will displace 6.6 gallons of water If this pump be run at 100 feet of piston speed per minute,—a very moderate speed,—it would displace 39,600 gallons per hour, without taking into account the slip, so that your pump is large enough for the engine mentioned.

The Toronto Electric Light Co. announce that they are completing arrangements for the distribution of current on their system for the purpose of operating clocks on standard time.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of the various Associations are requested to forward to us matter for publication in this Department not later than the 20th of each month.

WINNIPEG ASSOCIATION, NO. 11.

Mr. C. E. Robertson, Dominion Government Steamboat Inspector, delivered a few evenings ago the first of a series of lectures on engineering subjects, to the members of the above Association. He called attention to what it was necessary that a competent engineer should know before taking charge of a steam engine. An explanation of the technical terms used by steel plate manufacturers followed, after which Mr. Robertson went into an explanation of the various causes leading to boiler explosions, and pointed out the dangers most to be guarded against. An explanation followed of the different strengths of the various manufactures of iron and steel. His next lecture will deal with the calculations pertaining to, and the construction of, a boiler of sixty inches diameter and twelve feet long. The lecture was illustrated throughout with samples and blackboard diagrams.

KINCARDINE ASSOCIATION, NO. 12.

Editor ELECTRICAL NEWS.

SIR,—We have to report progress. We are holding our meetings regularly and the attendance is good. We have good and instructive discussions. We are also making arrangements to secure a teacher for a mathematical class.

ANDREW SCOTT, Sec.

139 BORDEN STREET, TORONTO, Oct. 15th, 1894.

Editor CANADIAN ELECTRICAL NEWS.

SIR,—Before you go to press (or at the latest shortly thereafter) I hope to be able to report the organization of new associations in Brockville and Carleton Place. I have visited Brockville a number of times, and often tried to interest some of the engineers in forming a branch of the C. A. S. E. there. I was there on business about the latter part of August, and met Mr. W. F. Chapman, Chief Engineer for the Brockville Carriage Co. (whose kindness to the writer will never be forgotten), and I took the responsibility of inviting him up to Toronto, to attend the Convention, which he did. On returning home again, he at once commenced work in earnest, and after a few communications with him, in reference to organization, I was most pleased to receive an application for a Charter. I am just in receipt of a full list of officers and members from Mr. James Aikens, the Secretary-elect of the new Association.

The Association will start with sixteen charter members, composed as follows :—W. F. Chapman, President ; Geo. Whitney, Vice-President ; James Aikens, Rec. Secretary ; Chas. Bertrand, Financial Secretary ; A. H. Franklin, Treasurer ; Edward Devine, Conductor ; Albert E. Henry, Doorkeeper ; M. Turkington, J. Grundy, E. Carr, Trustees ; Jas. Runnings, R. Turkington, W. Robinson, Jas. Window, W. Stanley Beaverstock, and D. G. Donovan. Several other engineers in the vicinity have signified their intention of joining the Association when it is organized.

Brockville Association No. 15 will be a valuable addition to the order, and under the direction of their worthy President, Bro. W. F. Chapman, its success is fully assured. I am pleased to see the name of A. H. Franklin among the officers as Treasurer. Bro. Franklin is a veteran engineer of over forty years' standing, and at the present time is chief engineer in the Brockville water works.

I shall be glad to hear from engineers in other towns where there there is any prospect of starting associations, and will give them the necessary information with pleasure.

ALBERT E. EDKINS,
Prov. Deputy for Ontario.

TORONTO, Oct. 27th, 1894.

Editor ELECTRICAL NEWS.

SIR,—As a result of considerable correspondence which I have had during the past four months with engineers in Carleton Place, a meeting was held there on Oct. 20th, to consider the advisability of forming an Association.

After the matter had been fully discussed, a committee was appointed to visit all engineers in the town, and ask them to attend a meeting on Oct. 27th at 8 P.M., for the purpose of organizing.

I am expecting to receive the charter members' names in a few days, when I shall forward them to the Executive Secretary.

I think it very likely that the Associations in Carleton Place and Brockville will be instituted about the same time.

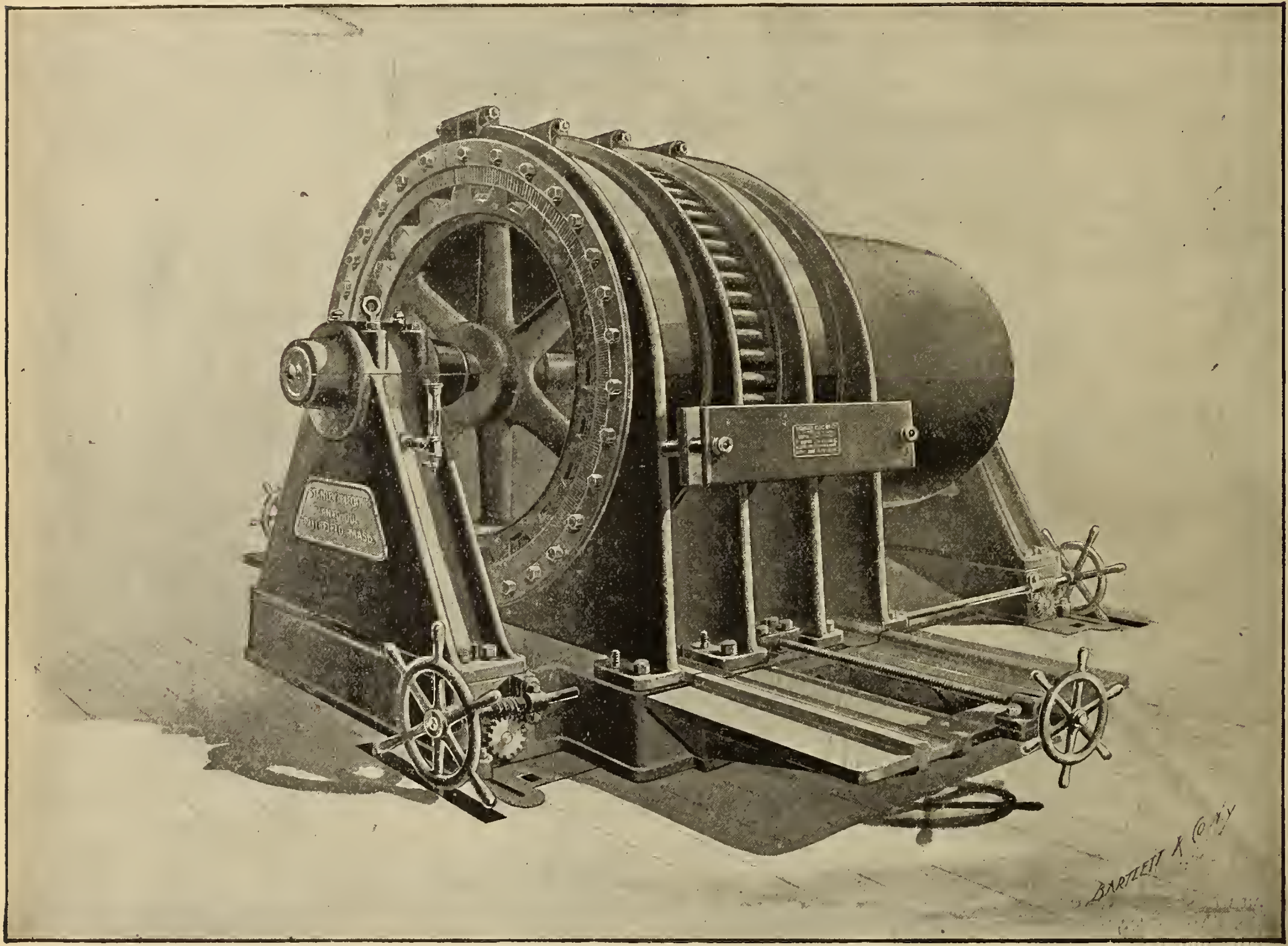
If any of the readers of the NEWS in the towns of Ontario would like to help start new Associations, and will write me, I shall be most happy to give them the necessary information, &c.

ALBERT E. EDKINS.
Prov. Dep., C.A.S.E.

A number of members of St. Laurent Branch, No. 2, of the C. A. S. E., Montreal, have recently withdrawn from membership in that body, and have formed themselves into a new organization, styled the "Mutual Society of Mechanical Engineers of the Province of Quebec."

THE MONTMORENCY POWER COMPANY'S TWO PHASE PLANT.

THE Montmorency Electric Power Co., of Quebec, intend to furnish several thousand horse power in the city of Quebec for incandescent and arc lighting and power purposes. This power will be obtained from the Montmorency Falls, a distance of nine miles from Quebec. For the original installation the Montmorency Electric Power Company will install three 675 H. P. two-phase A. C. generators of the S. K. C. type, built by the Stanley Electric Mfg. Co., Pittsfield, Mass. These generators are wound for 5,500 volts, and the loss in the line conveying the power to Quebec is so arranged that when the line is working at its full capacity, the generators will deliver 5000 volts at the sub-station in Quebec. In the sub-station will be arranged a switch-board for incandescent lighting, a switch-board for arc lighting and a switch-board for power work, all of which will be connected to the main line running from the power station at Montmorency Falls. The Falls altogether have a fall of about 300 feet, there being one perpendicular fall of 268 feet. The total amount of this fall, however, will not be utilized, as ample power can be obtained for all purposes for several years to come by utilizing only a small part of the total fall available.



THE STANLEY ELECTRIC CO.'S 240 KW. TWO-PHASE ALTERNATING GENERATOR.

These generators will be connected to water wheels which are already installed in the power station. The current will be delivered at 5000 volts pressure at the sub station and here converted to 100 volts for incandescent lighting, 30 volts for arc lighting, and 500 volts for power work, by means of transformers of large size. These will be placed in the sub station built specially for their reception, and a very complete arrangement will be provided for keeping the transformers cool by air blasts. The three 675 H. P. single phase generators are to be delivered at Quebec on or before May 1st, 1895, but in order to enable the company to take care of their work during the coming season, the Stanley Electric Mfg. Co. have loaned them two 320 H. P. generators which will be used temporarily.

PUBLICATIONS.

The Arena for November gives the place of honor to Kuma Oishi, A. M., Ph. D. a famous Japanese scholar, who considers "The Causes which Led to the War in the East," from the standpoint of his nationality.

Announcement is made of the publication at an early date, by the Electrician Publishing Co., Salisbury Court, Fleet street, London, E. C., of the thirteenth edition of the Electrical Trades Directory and Hand-book—corrected to January, 1895.

TRADE NOTES.

Messrs. F. E. Dixon & Co., of Toronto, the well known manufacturers of leather belting, have removed to No. 39 Front street east, where they will have increased facilities for their extending business.

The insolvent estate of Messrs. T. W. Ness & Co., manufacturers and dealers in electrical supplies, of Montreal, has been purchased by Mr. Rankin, a member of the late firm, at 30 cents on the dollar.

The Thompson Electric Co., of Waterford, have sold to the Light, Heat & Power Company, of Newmarket, Ont., an 800 light alternating plant, 600 light capacity in (Diamond) transformers; 400 lights installed; plant to be in operation this month.

The well-known belting manufacturers, Messrs. Robin & Sadler, Montreal, and the Haworth Belting Co., of Toronto, have merged into one concern, and will carry on business in future under the firm name of Robin, Sadler & Haworth, with offices at Montreal and Toronto.

Mr. C, R. Garrioch, of Ottawa, who for several years was agent for the Pioneer Electric Light & Power Co., and Mr Godard, formerly of the firm of Godard & Anderson, of the same city, have entered into partnership under the firm name of Garrioch, Godard & Co., for the purpose of doing all kinds of electrical work.

The Halifax Chronicle of Sept. 27th gives a description of the interesting electrical exhibit made by Messrs. John Starr, Son & Co., of Halifax, at the recent exhibition in the maritime provinces. The exhibit embraced "Starr" incandescent lamps, Lahmeyer dynamos, unique telephones, switchboards, measuring and testing instruments, &c., the dynamos being run by a Robb engine.

The Thompson Electric Co., of Waterford, Ont., have recently sold the following arc dynamos: Bowman & Zinkan, Southampton, 35 light; Hanover Electric Light Co., 25 light; Jos. Williams, Glen Williams, 45 light.

The Royal Electric Co. have made recent sales as follows: 800 light alternating plant to Conroy Bros., Deschene Mills; 60 light arc plant to Ottawa Electric Co.; 1500 light generator Wingham Electric Co.; 1800 light generator to Victoria Electric Light Co., Lindsay; 1400 light generator to Ratz Bros., Elmira; 2000 light generators to Hamilton Electric Light and Power Co., and Charlottetown, P. E. I. Light Co.

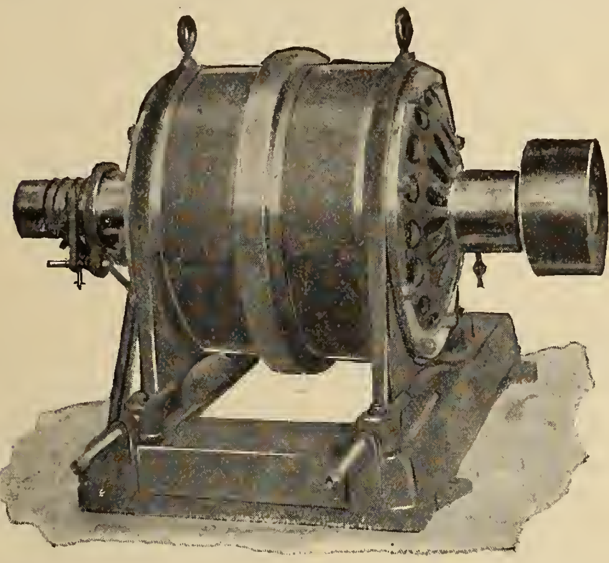
The Kay Electric Works, of Hamilton, Ont., were recently obliged, owing to dullness of trade, to call a meeting of their creditors. At the meeting the company's offer to pay 33⅓ cents on the dollar in settlement of their liabilities, was accepted by the creditors. In consequence, the company's works have not ceased operations, and it is probable that with the relief granted by their creditors and more active business conditions, they will meet with no further difficulties.

The manufacturing plant, patents, franchises, etc., of the Reliance Electric Mfg. Co., of Waterford, Ont., have been purchased by the Thompson Electric Co., of which Mr. J. W. Thompson, formerly President and Manager of the Reliance Co., is the Manager. The Thompson Electric Co. have the works in operation again, and will continue the manufacture of all kinds of electrical apparatus. Attention is directed to the company's announcement on front cover page of this Journal.

RIVALS OF THE STEAM ENGINE.*

THE title of this paper might lead one to believe we were on the point of a new era in engineering. By "Rivals of the Steam Engine," I simply mean, however, small powers of from one to sixty H.P. Some builders go so far as to say from 1 to 100 H.P. The economy of large plants, where all the best appliances for generating and developing power are used, may be seen from the duty test of the S. S. Campania's engines, which developed 30,000 H.P. (same as boiler capacity of World's Fair), with the low rate of 1.16 lbs. of coal per I.H.P. per hour. This plant has made a saving of .25 or ¼ lbs. of coal over the last large marine engine built. The great saving that may be attained by cutting the coal per I.H.P. per hour, down ¼ of a lb., will be seen to be great. In a plant of the above named capacity, the saving would be 3¾ tons in 1 hour, and 90 tons in 24 hours. But in small powers this saving is far from being attained. Some engines from 1 to 60 H.P. use from 6 to 10 lbs. of coal per I.H.P. per hour. These engines are mostly in the hands of incompetent persons, and the plant fitted with the poorest appliances. I think that in such cases the steam engine has a rival.

Its rivals are comprised in three classes—1st, the gas or explosive engine; 2nd, compressed air motor; 3rd, electric motor. I will first try to give a description of the gas engine and its mode of working. They are generally of the straight line, self-contained type, with very heavy frame. They are single acting. The connecting rod is directly attached to the piston, and is the length of the stroke, so as to give good bearing, having to act as the cross-head as well as piston. Their method of working is as follows: The gas is exploded once in every two revolutions—some having one explosion in three revolutions. The engine having just passed the centre, the charge of gas is exploded. The rapid expansion of the exploded gas drives the piston to the end of the stroke, when the exhaust valve opens and the returning piston drives the exhaust gas out. It then returns again, this time acting as an air pump, drawing in the next charge of gas and air. The piston then starts on the return, the exhaust valve remaining closed during this stroke. The gas is now compressed, and when the engine again passes the centre the explosion takes place, the piston being thus driven forward again, the same action taking place as before—the governor admitting the necessary amount of air and gas for the load. There are three different ways of exploding the gas—1st, by an electric spark in the combustion chamber; 2nd, by a gas jet in combustion chamber; and 3rd, by a tube heated red-hot, with which the gas comes in contact at time of explosion.



THE STANLEY ELECTRIC CO.'S TWO-PHASE ALTERNATING MOTOR.

It will be readily seen that the heat of the explosions would be likely to heat the cylinder to a very high degree, thereby rendering lubrication difficult. This is remedied by the cylinder being jacketed and the jacket surrounded by cold water. In places where a running stream may not be had a tank is used. The water passes through the jacket and returns to the tank, thus keeping up a constant circulation. Some engines in France, with one explosion in three revolutions, have no water jacket. The cylinder is supposed to be cooled by drawing in air at the second revolution and exhausting it, and then drawing in the air and gas at the third revolution. This necessitates a very high speed to be steady, but would be all right for carriages, avoiding the necessity of carrying a water-tank. These engines are now being used on carriages with great success, attaining a speed of from 8 to 10 miles an hour at a very nominal cost; and if improvements go on at the same rate as latterly, they bid fair to prove a strong competitor to the horse.

There are six different kinds of gases used in these engines, viz: Illuminating gas, gasoline gas, naptha, coal-oil, producer gas and natural gas. The illuminating gas at one dollar per thousand costs 2 cts. per I.H.P. per hour. Gasoline gas is mostly made by passing the gasoline through an atomizer, the current of air converting it into a gas. There is no danger from the gasoline. A tank is placed on the outside of the building, allowing only one quart inside, the connection being by a very small pipe, thus preventing any serious explosion in case of accident. Naptha and coal oil are protected in the same manner. The cost of gasoline per 1 H.P. per hour is one cent, gasoline costing 10 cts. per gallon. Naptha gas is formed by the air being drawn through a tank in which there is a material which absorbs the naptha, thus forming a gas. The cost per I.H.P. per hour is 8-10 of a cent., naptha costing 7 cts. per gallon. Coal oil gas is formed in the same way as naptha and gives an I.H.P. per hour at a cost of one cent, coal oil costing 8 cts. per gal. Producer gas, or gas made from anthracite coal, takes about 1¼ lbs. of coal per I.H.P. per hour, equalling .35 of a cent—coal costing $6.00 a ton. The cost of natural gas where available is nominal.

There is one place in this city using light that I think could make a saving by introducing a gasoline engine and dynamo. The cost of light is one cent per ampere per hour. They are using three hundred and fifty (350) lights at one ampere per hour an average of four hours per day, which equals 1400 amperes, at a cost of $14 less 15 per cent discount, equalling $11.90 cents. Now let us see what saving would be derived from using a gasoline engine, one H.P. giving 10 lights of 16 C.P.—350 lights requiring 35 H.P.—allowing 15 H.P. for loss in belt and machinery, equalling 50 H.P. This would cost 1 cent per H.P., 50 cts. in 1 hour, or $2 for every four hours. Allowing 50 cts for repairs, there would be a saving of $9.40. The lights are not generally on all together, but I took them in that way for the purpose of the comparison, to show the saving that might be attained.

I know of another place where a man pays 25 cts. a day for one H.P., using it for about 6 hours a day. The same service performed by a gasoline engine would cost about 10 cts. a day. Another place where they would do good service is in small yachts, saving the room of a boiler and being more economical. A small boat here in the bay, developing about 8 H.P. if driven steadily for 12 hours, would consume ¾ of a ton of soft coal, costing $3.00, while using a gasoline engine the cost would be 8 cts. an hour, equal 96 cts.; and the boat would have made better speed, owing to the absence of displacement caused by the boiler.

The reason these engines are so economical is: we receive power only in one way, that is, by heat. In the steam engine we transmit this heat to water, which forms steam, losing, as you all know, 967 heat units out of every lb. of coal; but in gas engines the products of combustion do their work directly on the piston, there being no loss through transmission; therefore, I think you will agree with me that now that gas can be produced from coal at the rate of 1¼ lbs. per I.H.P. per hour—which can and will be improved upon—the gas engine has a brilliant future. The largest gas engine so far built is 100 H.P., and one of its great advantages is that there is no getting up steam in the morning.

We will next take up the compressed air system, which is extensively adopted in Paris—which has at the present time a plant with a capacity of 25,000 H.P. In the first place, we must have a large plant with a large unit of power and all the latest appliances, so that the plant will give the utmost economy, built where cheap water could be had for condensing purposes, using triple expansion engines and the very best compressers. The next thing to decide is whether the pressure shall be 200 or 500 lbs. per sq. in. The saving of high over low pressure is small, the pipes being much smaller for high pressure, thereby making high pressure favorable—using reducing valves at the point of distribution. It is a well known fact that in the best air compressers we only get 50 per cent. of the efficiency of the engine used to drive them, so that to make a profitable power we must in some way regain the power lost in compression. This is done by passing the air through hot water—kept hot by a coal oil lamp or small fire. In this way damp, hot air is made, to which is given the properties of steam. The cost of heating the air is only 1 cent per H.P. When this heated air is used expansively, it gives the expansion curve on indicator diagram, just the same as the steam engine. In heating this air we regain the 50 per cent. we lost in compression. Deducting 5 per cent. for friction and other losses we get 95 per cent. at points of distribution. In selling steam for power, we have no means of registering properly the amount of steam used, a man with an automatic engine paying as much as a man with a slide valve engine, and using less steam. But with the compressed air system the amount consumed may be registered. The air not being heated until just before entering the engine, a man pays for just what he consumes. I think also that compressed air would be advantageous in street railway work. In electric railways there is a great loss in transmission in the wire, besides the danger to life, and inconvenience in cases of large fires. In the winter time there is a great inconvenience by the trolley wires being coated by ice, which is an insulator, and must be broken through; and in wet weather great loss through leakage. If anything happens to stop the power at the station for one minute the whole system is paralyzed. With compressed air each car has its own motive power, thus slight stoppages at the station would not inconvenience them. Electric cars give only 45 per cent. of the power applied to them, while compressed air gives from 70 to 80 per cent., thus effecting quite a saving. This is from tests made by Mr. C. E. Haupt, C.E.M.E. Where compressed air is distributed to consumers, the air is generally received into a large tank in the building. No damage could be done by the explosion of this tank, the air merely escaping with a hissing sound. Experiments made by some mechanical engineers in Paris showed this effect. A weight was allowed to fall on the tank, so as to rupture it, with the foregoing effect. We thereby make a saving in insurance over handling a steam plant.

In testing the saving, if any, by using 400 lbs. per sq. in., it was found that it took as many cubic ft. of air at 400 lbs. per sq. in. as at 200 lbs. per sq. in., and the theory advanced was that the increased friction on working parts overcame any advantage gained by very high pressure. Now that high pressure in steam engines is becoming universal, I think a little study in this direction would be profitable.

I will now conclude with the electric motor. The electric motor has been in use since it was found that a dynamo with conditions reversed would act as a motor, and it has kept on improving until it has become a much-used motive power. In large plants, where a great deal of power is distributed by long lines of shafting, the electric motor shows a great saving by driving directly the machines or the shafting of a single room. The loss in long lines of shafting, due to friction and slip of belts, makes only about 50 or 60 per cent. of the engine power available, while with electric motor we get 70 to 75 per cent of the engine power. Where the dynamo is the actual fly-wheel of the engine a little more saving is attained on account of the slip of the belt which is sure to follow by running from a large wheel to a small one necessary to give the generator the required speed. In direct connected generators the speed is attained by the large diameter of the armature, thus giving it rim speed, and also by the increased number of poles. I think in a well equipped station, with direct-connected dynamos giving 70 per cent. at points of distribution, if the distance be not too great, it could be made a cheap power. Another way in which the electric power may be utilized is by means of transmission from a water-fall. But as the great cost of copper conductors is one of the chief items of such a plant, we must first look at any saving to be made in this direction. As we well know the higher potential or pressure we use, the less the size of the conductor required. A line carrying a thousand volts would cost $80 00 per mile. By raising the voltage to ten thousand we reduce the cost to $10.00 a mile. Most motors are run by direct current, but no direct current machine can make a voltage of over 1,200 to 1,500 volts, the insulation of the commutator not being able to stand any higher voltage, so that we have to look for a new kind of current. This is found in the alternating or multiphase currents. With these currents, by means of transformers, we can raise the current to any potential we like, and lower it again to any potential required at points of distribution, but the difficulty with the alternating current is that the alternating motors have to be brought up to speed by some other power, before they will carry the load. This difficulty is remedied by the use of the multiphase current, which is merely a double alternating current. A machine using this current can be started up under full load. Another way in which this difficulty may be remedied is by having in a central station an alternating motor, driving direct current dynamos, thus giving direct current to the consumer. The commercial success of such a scheme depends upon the first outlay for conductors and plant, and the dividend to be derived on such capital. Edison is credited with saying that current could not be as cheaply sent to Toronto from Niagara as it could be made on the spot, with the best compound engines.

In summing up this paper, I think you will agree with me that in some conditions small steam engines have a rival. We ought therefore to look around us and observe these powers, for at some time they may fill some of our necessary requirements.

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*Paper by Mr. Geo, Mackie, read before the members of Hamilton Association, No. 2, C.A.S.E,

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IT has been decided that the next meeting of the National Electric Light Association of the United States shall be held in Cleveland, Ohio, on the 19th, 20th and 21st of Feb., 1895.

THE Dominion Government has announced that the new Electric Light Inspection Act will go into operation on the first of April next. The Controller of Inland Revenue is purchasing the necessary electrical testing appliances, and the gas inspectors whose services it is proposed to utilize as inspectors under the act, will be instructed in their duties during the coming winter.

IT is very likely that the recent opening of the Hamilton, Grimsby and Beamsville Electric Railway, may be of greater significance than is now recognized in marking the opening of a new era in the industrial history of Canada. The Niagara Falls electric road has a special function as serving a tourist route, and the H. G. & B. road is therefore the first electric road in Canada of any considerable length which serves a purely local traffic. The question of light railways as feeders to trunk lines, and as drawing freight and business to railroad centres, is a very live one. In England the question has lately been the subject of much discussion, as a means of affording relief to the agricultural depression from which the English farmer is suffering, by cheapening the carriage of his produce from the farm to the large transportation lines. On the continent of Europe large sums have been spent, provided on interest guaranteed by the government, on light railways for the same purpose, notably in France and Italy, though on the whole these roads have not paid interest on the investments. The question of drawing trade to the larger towns by passenger traffic on such railways, seems to be more particularly a question affected by the conditions of life prevailing in Canada and the United States. The H. G. & B. road is designed to serve both passenger and farm produce traffic, and though the results of this road should not, and will not, be conclusive in settling the question, either one way or the other, they will give most valuable information as to what are the essential conditions to be met by such roads in order that they may be commercially successful.

IT should be pointed out to those who contemplate becoming members of the Canadian Electrical Association, that there is financially no reason for deferring sending in their applications to the Secretary. The financial year begins in June, and those joining between now and next June are not assessed for the current year, their membership dues dating only from the year beginning with June, 1895. The Ottawa meeting already promises to be most successful, and apart from the interest of the picturesque capital city, Ottawa has more to show the convention in the commercial use of electricity than any other town of its size on this continent.

THE thirteenth annual convention of the American Street Railway Association took place in Atlanta, Ga., on Oct. 17th, 18th and 19th, and is declared to have been one of the most successful ever held. Mr. Granville C. Cunningham, manager of the Montreal Street Railway, and Mr. Griffith, manager of the Hamilton Street Railway, were present. The former was elected a member of the Executive Committee of the Association. The nominating committee recommended that the next meeting be held in Montreal, Que. This met with spirited opposition from a section of the membership who were desirous that the meeting should take place in Philadelphia. The question was submitted to vote, when by a large majority the decision was given in favor of Montreal. Mr. Cunningham expressed his pleasure at the decision. He assured the members that there would be no difficulty in having supplies brought to Montreal for the exhibition which forms such an interesting feature of the annual meetings of this Association. The date for the convention in Montreal has been fixed for October 15th. We bespeak for the American Street Railway Association a hearty welcome to Montreal and the Dominion on the occasion of this their first visit, and feel assured that while here they will find much that will prove interesting and perhaps instructive from the electrical standpoint.

IT is announced that the investigation before the county judge into the alleged recent attempt at boodling on the part of some of the aldermen, in connection with the Toronto street lighting contract, will be held in the early part of November. Whatever may be the outcome of the investigation, the bare fact that such an accusation should a priori obtain credence to the extent that judicial investigation is considered necessary by a majority of the aldermen themselves, is a commentary upon the present condition of municipal institutions in Canada, which should be pondered over by those who have been inclined to civic ownership of a street lighting plant. For the credit of Toronto we hope that the accusation will prove groundless in this case, but that it should so readily be thought possible is sufficient to make prudent men pause before increasing the industrial interests committed to the care of the municipality. A lighting contract is let once in five, ten or twenty years, but a lighting plant would require continual purchases of supplies and frequent employment of men, with continual opportunities for jobbery and corruption; which, being on a smaller scale in each instance, would be the more difficult to detect, whilst the instances being more wide-spread, the effect would be more demoralizing to the community at large, than any one big "boodle" confined to a few already corrupt individuals. With the business parallel of ratepayers as shareholders and aldermen as directors in the municipal concern, and the directors under suspicion of abusing their trust for their private gain, what sensible business man would vote for increasing the opportunities for the suspected dishonesty.

THE late convention of the Canadian Electrical Association at Montreal marked a distinct advance. The general quality of the papers read stood higher than at any previous meeting. Some of them would have done credit to the older and larger associations established in the United States and England, and were worthy of fuller discussion than they actually received. In this respect the meeting brought out the present need of the Association, and that is increased membership. Though some of the papers provoked lively discussion, the good in them was not threshed out as thoroughly as would be the case with a larger membership of all classes, insuring that a sufficient number of speakers familiar with the subject of any one paper, might be present to give it full discussion. It is much to be hoped that many new members will be added to the Association before the convention to be held at Ottawa next September. Any objection that the annual dues were too high for an association which at present only holds one meeting during the year, was met by the action taken at Montreal, reducing the annual subscription of active members to $3.00 and of associate members to $2.00 per annum. To those who have refrained from joining until the Association should have successfully passed the initial stage and become an established and representative body, it may now be said that it is both successful and established, and it lies with those who are not already members to make it thoroughly representative by joining it. At the cost of time, labour, and personal inconvenience to many of the members, the Association has been advanced to that point, that the tone of its meetings and the character of the papers presented, are in advance of its size, and it may fairly claim from those who have awaited results, that they fulfil their implied pledge by swelling the membership and attendance. The Association has fully justified its formation; it is doing good work in establishing solidarity of feeling amongst electrical men in Canada, and in promoting intercourse amongst them. By the efforts of its present members it has attained a good standing, and its further rapid progress must depend upon increased membership. The fees are little more than nominal and there is no reason why every electrical man in Canada should not be a member, and every reason why he should for his own personal benefit, both directly by attending the meetings and rubbing brains with his fellows, and indirectly by promoting the growth and increasing the weight of a representative Canadian electrical body, which may speak with the authority to command attention if need be in matters of common interest.

THE Canadian Law Times for September in an article on the law of "nuisances" and "furious driving" as illustrated by recent decisions, deals with the probable bearing on the noise and speed of electric street cars. The conclusions are decidedly adverse to trolley cars as at present operated. It is to be presumed that the article is a correct statement of the legal aspect of the case. But though laymen are not competent to discuss what the law is, they are entitled to form an opinion of what it ought to be, provided they can give reasons for the faith that is in them. The article indicates the probable application to electric street cars of the law governing the speed of steam railroad locomotives where they are permitted to use the highway, and also that governing ordinary vehicles. But it is well to remember that in the endeavor to adapt itself to new conditions law sometimes requires assistance from the legislature. To ignore this is to violate the wholesome principle that the law should be respected but not worshipped. Otherwise good law may sometimes be poor justice. And underlying the whole treatment of the subject from the point of view of precedent there seems to lurk a fallacy in the form of an assumption that the electric street car is an intruder on the highway—either allowed only on sufferance, or constituting a tyranny to be tempered by legal injunctions. A steam railroad which may be allowed to run for some distance through the public streets is a real intruder. But the electric car is merely a new form of vehicle using the streets for the primary purpose for which they were originally expropriated, and for which they are maintained at the public cost. In that it is a vehicle for general use and so of greater benefit than private conveyances, it may be rightly given by contract certain privileges over the latter, such as the right of way; and within the limits of safety to other vehicles and foot passengers, be permitted to travel at a higher rate of speed than other vehicles. The fact that it moves only along the line of its rails, and that its course is therefore perfectly obvious to the other users of the streets, determines its safe speed at a considerably higher limit than, for instance, the erratic butcher's cart. As a noise producer the trolley car is certainly very effective—a more melodious substitute for the clanging bell would be welcomed—but it is not in it with the early morning ice cart, or with heavy trucking of any kind. It is to be expected that the best residences will seek streets that are near but not on a trolley line. In other words the tendency will be to drive residences off trolley streets and turn them into business streets, but this also is the tendency where there is much traffic of any kind on a street, without it being necessarily a good reason for stopping the traffic. The article in the Canadian Law Times points out that an annoyance to daintiness, fastidiousness or delicacy does not constitute a legal nuisance, which must be such a physical annoyance as materially affects the ordinary comforts of life to people of all ranks, ages and states of health. The trolley car must keep its noise within this limit, and it should have no difficulty in doing so, whilst such a provision as that in the Toronto Railway Act that the street railway speed shall be "determined by the City Engineer and approved by the Council" seems to satisfactorily cover the question of speed, by placing its control in the hands of those most affected by it and best fitted to judge what best suit them, namely, the citizens of the town where the street railroad operates.

In the case of the Toronto Street Railway Company v. the Queen judgment has been given in the Exchequer Court at Ottawa, against the plaintiff. The company took suit for $56,000, being the amount which they had paid as duty on rails imported in 1891, 1892 and 1893, and which weighed 69 lbs. per yard. They asked for a refund of this amount. The customs department had exacted a duty of $6.00 per ton, claiming that this was the correct reading of item 88 in the tariff, bearing on steel rails. The contention of the company was that the rails, imported by them, should have come under item 173 of the tariff, which provides that rails "for use in railway tracks," weighing over 25 lbs. per lineal yard should be admitted free of duty. The real question at issue is whether the term "railway" included tramways. The judgment of Justice Burbidge is one of peculiar interest to all concerned in the development of electric railroads. It is argued that in 1887 the government were endeavoring to promote two interests, which somewhat clashed, namely, the manufacture of iron and steel, and the building of lines of railways; so they put a duty on light rails and admitted the heavy ones free. They did not wish to promote the building of street railways, contended the Court, as that opened up no new country, and so in the term "railway" they did not intend to include street railways. In the new tariff of 1894, the government left no doubt as to their position on this matter, it being expressly stated that steel rails for tramways and street railways shall be made dutiable at 30 per cent., while the free item in the tariff reads very plainly, so as to exclude "rails for use in the tracks of street railways or tramways." In a word, according to the tariff in existence to-day, a steel rail weighing over 45 lbs. is free for a steam railway, but is taxed 30 per cent. when imported for a street railway. With the development that has taken place in the building of electric railways, not only as a most efficient method of propulsion in all our larger towns and cities, but also as a means of connecting various municipalities throughout the country one with the other, it is difficult to understand the considerations that influenced the government in fixing the tariff on this item as they did at the last session of parliament. It is worth remembering that out of fully 1,000 street car plants existing in the United States and Canada, at least 25 per cent. of these are operated by electricity. Or to put it another way, where in 1891, there were only seven electric railways in the United States, it is computed that to-day there are probably over 500 cities in that country equipped with electric roads, while progress in this line in Canada has been greater than in any other part of the British empire, excepting the mother country. Within the short period of twelve months, the development in the building of electric roads in Canada has been very remarkable. We may refer simply by way of suggestion and illustration to the lines recently completed, connecting the towns of Galt and Preston, and to the projects under way uniting important sections of country in the vicinity of Hamilton, Dundas and Guelph, as also the proposition now on foot to build an electric railway between Ottawa and Brockville. In all parts of the Dominion projects of this kind are being planned and in many cases put into operation. To what extent electricity will, in the future, become a competing element with steam in the transportation of both passengers and freight along our great highways need not, perhaps, be discussed at this moment, but what has already been accomplished in the case of the Niagara Falls Park & River Railway, and what is projected by the Canadian Pacific in certain parts of British Columbia, is at least suggestive of large development in this direction, in the not distant future. A New York electrical journal points out, in this connection, that steam railway managers have "in more than one instance of late had to face the electric road as a competitor; and we believe the time is not far distant, when a serious struggle for supremacy between the two, at least for short haul traffic, will be in full progress." How far also the government should draw a distinction between the development of interior sections of the Dominion, and the growth of our towns and cities is a question that will come home to capitalists in all parts of the Dominion. Lines of electric railway are being built in every direction, and who will say that both city and country have not been benefited, as a result of this development? It is quite likely that an appeal will be made from the judgment of the Exchequer Court at Ottawa, and this case of the Toronto Street Railway go to the Supreme Court. To this extent, the case is yet, perhaps, sub judice, but despite the fact, capitalists will not hesitate to take contention with Justice Burbidge in his judgment as already given out from the Court, and see more clearly than before the unfairness of the tariff of 1894, as bearing on steel rails when used for street railways and electric purposes.

THE A. S. M. E. IN CANADA.

There is little doubt that there is a very general regret that the relatively few cities in Canada suitable for holding a meeting of the American Society of Mechanical Engineers makes it unlikely that meetings will often be held there, for a long time to come, at least. The recent experience of the society with Canadian hospitality and good fellowship is one that will be long and most pleasantly remembered. From the moment of arrival in Montreal to the moment of final departure nothing that the kindest hospitality could suggest or the most openhanded generosity provide was neglected or omitted, and no honor, social or otherwise, was by the Canadians considered too great to be bestowed upon their visitors.

It is to he hoped that the result of this interchange of courtesies by influential men will result in much good to both sides. Engineering and science recognize no political boundaries, nor should they; nor is it true, as Senator Frye recently declared, that "Canadians hate Americans," a declaration which, though referred to in some of the addresses of welcome, was contemptuously dismissed as unworthy of notice by sane men. But if it were true, and the recent visit to Montreal and Ottawa showed how Canadians treat those whom they hate, then we are curious to know how they treat those whom they love.—American Machinist.

LEGAL.

The Sherbrooke Mutual Fire Insurance Co. brought action against the Bell Telephone Co., to recover $1,900 insurance paid to a tenant of the building in which the company's exchange was located at Richmond, Que. The plaintiffs claimed that through negligence on the part of the defendants a cross had occurred between an electric light and telephone wire, which resulted in setting fire to the building. Mr. Justice Archibald held the defendants to be liable and gave judgment for the amount claimed.

PERSONAL.

Mr. Thos. Ahearn, the well-know electrician, of Ottawa, has recently returned, with his family from a visit to Europe.

Mr. Spencer, lately with the Ottawa Electric Railway Co., has removed to Albany, N. Y., having secured a position with an electrical company in that city.

Mr. E. B. Merrill, who was for several years instructor in electricity at the Toronto Technical School, has been elected principal of that flourishing institution.

Mr. D. H. Keeley, superintendent of Government Telegraphs, is at present in the Maritime Provinces, supervising repairs to the cables between Grand Manan, Campobello and Eastport.

Mr. Duncan McDonald, who has been connected with the company for a number of years, has been appointed superintendent of the Montreal Street Railway, to succeed Mr. Franklin.

Mr. I. B. Mackay, superintendant of construction of the Niagara Falls Park & River Railroad, was tendered a banquet at the Baltimore House, Chippewa, and presented with a handsome gold watch by the officers and employees of the company, on the eve of his departure for his home in Montreal.

THE ONLOOKER.

A RECENT news item bears the information that in connection with a certain proposed extension of the electric railway system in Hamilton, an attempt will be made to do away with trolley wires, and adopt in their stead, as a working conductor, a sectional rail laid between the tracks. The suggestion opens up a wide subject for discussion. Though the service from the trolley system generally in vogue to-day is not in every respect satisfactory, yet electricians have found it a difficult matter to furnish a substitute that can be made practicable. The Onlooker, in course of conversation the other day, mentioned this Hamilton proposal to Mr. James Milne, electrician at the main station of the Incandescent Light Company, Toronto. His judgment is, that it will be a long time, if ever, before this system of electric street car propulsion can be made workable. "There will always be the difficulty," said Mr. Milne, "of moisture affecting the electrical current. We experience a difficulty as it is, from the fact that in a measure the trolley system is underground. The trouble would be aggravated were a sectional rail adopted, or for that matter any of the proposed conduit systems."

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It is natural to expect, with the wonderful growth of electricity as a method of street car propulsion, and with the very wide developments in electrical science in all its different branches, that earnest and determined efforts should be made to improve on the much abused trolley. "The ideal system," said Mr. Milne, "is, of course, the storage battery, but it seems a hard matter to overcome a number of difficulties that beset every experiment made in that direction." At the same time the Onlooker is reminded that there are, at least, a few cases where the storage system seems to have worked well. Storage battery traction has been adopted at Birmingham, Eng., with sufficient success to show that the storage battery may become an efficient competitor with other methods of traction. These, however, are exceptional cases, and will hardly prove the rule. There have been many experiments made with the open slot conduit. At Buda Pesth, Hungary, such a system has proven a practical and commercial success for some time. The Onlooker has been interested in a paper of some length by Mr. Joseph Sachs, and published in a late issue of Cassier's Magazine, where the whole subject of conduit electric railways is discussed at considerable length. This writer remarks that all of the open slot conduit methods embody the slotted trough or conduit running parallel and adjacent to the tracks with the necessary contact wires supported inside upon proper insulators. The current is supplied from a central source and the wire is continuously charged along its entire length. Mr. Sachs says he is of the firm belief that an open slot continuous wire conduit can be devised that will be commercially practical and efficient at a cost which will certainly compare favorably with the cable. The main difficulty in conduits that have previously been experimented with has rested in the meagre dimensions and bad location of the contact wires, and lack of proper drainage facilities and protection of the wires from moisture. With the amount of study that is being given to this question by many of the best electricians of the country it is not unreasonable to expect that Mr. Sachs's expectations will yet be realized, just as Mr. Milne has remarked that the time will come when the storage system will be an actuality. The Onlooker must say, however, that this time yet seems a good way distant, and especially where climatic conditions are of the character that we experience in Canada.

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The system in which the current is supplied to the car by a continuous bare conductor laid upon the surface of the street received the consideration of Edison some time ago and was patented. It, however, has not come into the realm of practical everyday operations. Then there is what is known as the magnetic service contact railway, devised by the late C. J. Van Depoele, where the working conductor is composed of sectional bars or straps of magnetic metal supported upon the conduit so as to be flush with the surface of the street, and insulated from one another. A method somewhat similar to this is that in which contact boxes are located at intervals along the road. There has also been made recently an experiment at New Haven, Conn. In this the switch boxes are located in a slotted conduit of rather small dimensions and are separated from one another by a distance of several feet. The tops of these boxes form the contact conductor and are so arranged that they can be depressed by the current collecting plow projecting through the slot. More ideal, perhaps, than any of the conduit methods is the induction electric railway, in which all contacts, whether in a conduit, or on, or above, the surface of the street are eliminated. A Mr. M. Dewey is working on this induction system at the present time. It will thus be seen that the Hamilton people, should they experiment on the conduit system, will not be the only ones who are endeavoring to get somewhere along that line. That there are difficulties in the way is clear from what has been suggested in these comments.

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It is perhaps not generally known that the Incandescent Light Company furnish power to the Toronto street railway at from 500 to 650 volts, and this circumstance has caused Mr. Milne, no doubt, to give considerable thought to the question of electric propulsion of street cars. He believes that the time will come when over-head wires will be so adjusted as to completely supplant the present trolley methods. A German engineer, Eugen Langen, of Cologne, has worked out plans for what he calls a suspension road. Mr. Langen proposes to carry the two lines of rail on only one line of poles by means of brackets. The floor of the suspended car is to be about 17 feet above the street surface and the posts therefore would have to be about 26 feet high. Electric motors are to be used for propulsion, the current being supplied through a contact strip carried along the girders. In the twin towns of Eberfield-Barmen, in Germany, the building of a road of this kind is being seriously considered.

× × × ×

In the case of the suit brought by Mrs. Agnes Hartford, in this city, against the Bell Telephone Company, the Toronto Electric Light Company, and the Holmes Protection Company for $25,000 damages on account of injury sustained by the falling of a live wire in King street west some time ago, the Onlooker has noticed that the methods of insulating and hanging wires in use here have been severely criticised by Mr. Fred. J. Cross, of New York, an electrician of Cooper's Institute, who appears to have been brought on as an expert witness for the plaintiff. Mr. Cross ventured the opinion in the witness box that the insulation here is by no means of a high grade, and that in New York, were no better methods adopted, it would be difficult to obtain insurance from any insurance company. The Onlooker asked the opinion of a local electrician on this question, and he admitted that there was room for improvement in our methods of insulating. "We are sometimes," he said, "too careless in the work of outside construction. But why an electrician has been brought all the way from New York to give evidence in a case of this kind I do not know. We have many capable men in Canada who could have spoken with just as much knowledge and authority on this matter. The best insulating work that I know of in Canada is to be found in Montreal in connection with the work done by the Royal Electric Light Company." In Mrs. Hartford's case a non-suit has been entered for the Bell Telephone Co. Damages have not yet been fixed against the other two defendants, but will probably represent about $8,000.

BOILER COMPOUNDS.

AT a recent meeting of Hamilton Association No. 2, C. A. S. E., a paper was read by Mr. McKinley on "Boiler Compounds," as follows :

IN considering the value of boiler compounds two things should always be known, first, the nature of the scale ; second, the chemical and solvent action of the mixture on that scale. The scale on the boiler represents the insoluble part of the total solid of the water used with the suspended mineral and vegetable matter. As these insoluble salts differ both in quality and quantity in various waters, so must the quantity and amount of the scale formed vary. In some districts the amount of insoluble solids in a water will be represented by from 2 to 5 grains per gallon, others from 20 to 25 and even higher, thus showing that it is unprofitable to use the same amount of boiler compounds in all localities. It may be supposed that scale is formed only by precipitation from the evaporation of the water to such an extent that all the total solids are thrown out of solution, but the precipitate begins to form long before this. When a solution containing the insoluble salts of lime, carbonate hydrate and a sulphate is raised to the boiling point, approximately half of the salts are precipitated without any evaporation, because the lime salts are much less soluble in boiling than in cold water. Hydrate lime soluble in cold water, 750 parts hot, 1.650 parts ; sulphate lime soluble in cold water, 400 parts hot, 500 parts ; carbonate lime soluble in cold water, 23,000 parts hot. 40,000 parts. There is no doubt that most of the scale is formed during the night when the water is in a quiet state, as it then has a better chance to become firmly attached to the flues and sides of the boiler. The chemical nature of the scale for the Hamilton district may be represented by : Carbonate of lime, 65 per cent.; carbonate of magnesia, 20 per cent.; sand, 3 per cent.; sulphate of lime, 4 per cent.; oxide iron and alumina, 2 per cent.; invisture, 6 per cent.; total, 100.

In a boiler or series of boilers using, say, 1,000 gallons of water per day, the deposit would be for the Hamilton district 9,000 grains of one pound, or in one week, six pounds. There can be no doubt that in blowing off most of this is removed, but the layer in immediate contact with the metal is not disturbed. In a boiler with thick hard scale the cheapest way to remove it is with a chisel or instrument for the purpose, then follow with a good compound. In a clean boiler a good compound should prevent the precipitate from settling into a hard state and prevent it from growing. It must be remembered that it is easier to prevent a precipitate than to dissolve one when formed, and also in a hard slate-like scale only the surface is acted upon ; while the precipitate is suspended, it is subjected to the full action of the solvent. A boiler compound may have a three-fold action, a slight chemical, a solvent and a mechanical action. This slight chemical action may change some of the salts and thereby retard the formation of the scale ; but in the majority of cases the solvent and mechanical action are the two important factors. The best solvents are caustic soda, chloride, ammonia, hyposulphite soda, chloride soda and sulphate of ammonia. The best mechanical agents are bark extracts, molasses and glycerine. In all probability the most effectual work of a compound is to keep the precipitate from settling hard. Suppose you have a week's precipitate, of seven pounds, in the boiler, and you have used through the week four gallons of a compound, carrying eight pounds of caustic soda, chloride soda, etc. These salts having a strong affinity for water, keep the precipitate soft, so it is readily detached when blowing off. If the precipitate consists of clay and sand, with a small percentage of lime, salts, bark extracts and molasses are the most satisfactory things to use. When the water contains carbonate of lime I would not advise using carbonate of ammonia or soda in the compound, as carbonate of lime is very insoluble in water containing alkali carbonates, the solubility being about one in 65,000 parts.

I submit the following formulas for compounds : No, 1—Caustic soda, 30 pounds ; (salt) chloride soda, 30 pounds ; oak bark extract 5 pounds ; water, 15 gallons. Use 2 gallons twice a week.

No. 2—Chloride ammonia, 10 pounds ; molasses, 50 pounds ; water, 10 gallons. Use 2 gallons twice a week.

In the discussion that followed Mr. McKinley said that he thought there was no composition with which a boiler could be painted to prevent scale adhering ; also that sal soda (washing soda) helped rather than prevented scale.

ELECTRIC RAILWAY DEPARTMENT.

THE NEW ELECTRIC STREET RAILWAY AT ST. JOHN. N, B.

THE city of St. John has an entirely new system of electric street railway. The work from start to finish was carried on under the direction of most competent overseers and is thorough in every respect. There is not a better track in America, the cars are finished comfortably and almost elegantly; new engines, boilers and generators have been placed in the power station; the car sheds and offices of the company have been enlarged and extensive repairs made on each. The company has a thoroughly reliable and competent staff of conductors and motormen. It will thus be seen that St. John is abreast of the times in possessing a first class electric railway.

A. R. BLISS, Electrician.

The first electric street railway in the city was opened up in the spring of 1893, and took the place of the old horse-cars which had been in use four or five years prior to that date. The company that owned and operated the road at this time was known as the Consolidated Electric Co. It had its power station on Union street and did a large share of the city lighting. The company afterward became involved financially, and last April the railway was put up at auction and sold for $90,000 to a company composed of the following named gentlemen: Sir Wm. C. Van Horne, James Ross, H. P. Timmerman, H. H. McLean and Col. J. J. Tucker, directors; Sir Wm. C. Van Horne, President; James Ross, Vice-president; F. W. Warren, Secretary-treasurer.

The road had practically fallen into decay. The first thing therefore on the part of the new company, was to order new and suitable rails from England. This done, they immediately began operations and employed steadily between 350 and 500 men. Work was commenced on the streets which had not been before covered by the railway, but which were to form portions of the new circuit which the company proposed to make for the better accommodation of the citizens. Ground was broken on the second or third day after the arrival of the rails at the corner of Crown street and King street east. The men were divided up so that the work was going on all over the city at the same time. The work progressed at the rate of from 350 to 400 feet per day on each track.

The "T" rail was adopted instead of the old flat rail. The rail now in use is 6½ inches deep. It is placed on heavy cedar ties or sleepers firmly bedded in ballast. The rails are bolted together by means of six bolts having a fish plate on each side, thus making a true and substantial job. The special work, that is, the intersection, was made by the Canada Switch Co., of Montreal. This work was made from diagrams showing only the angles of the streets. The rails were bevelled and slotted in the shops and shipped straight to the streets where they were put together for the first time, showing at a glance the great care and accuracy with which the rails were handled in the shops. The streets that are double tracked are Prince William street as far as Indiantown wharf, where the river boats discharge, and Brussels street. The remainder of the streets have single tracks.

POWER STATION.

The old over-head system was taken down and replaced by a better and more recent one. The wire is copper about ⅜ inch in diameter carried on a span wire reaching from pole to pole across the street, having all the necessary frogs, insulators, etc. The cars, which were built expressly for the St. John Railway Co. by the Ottawa Car Co., of Ottawa, have excited the admiration of all who have seen them. They are 24 feet in length and are provided with a vestibule at each end so that the driver and conductor will be completely protected from the weather. The interior finish of the car is of mahogany, upholstered in English Wilton, with bevelled plate glass mirrors, birds eye veneered ceiling, polished brass trimmings and automatic Pullman car curtains. Each car has a coal stove of the new Gurney style which rests upon the seat in the centre at one side of the car. The register of the fares is operated, not by means of a cord, as in the old cars, but by means of an iron rod to which short levers are attached. Each car is provided with a clock, and the whole aspect of them is most cheerful and comfortable. The new cars will not require to be turned, so that neither Y's nor turntables will be necessary, for the motor men can operate them from either end, both ends being alike. This arrangement will save much time and will be a great convenience in every way. The new cars will be provided with life saving fenders. The car bodies rest upon solid iron trucks and have powerful springs, and running on a perfect road bed they will be entirely free from all jolting and jarring which have made the other cars so uncomfortable. It may be said of these cars that they are equal in appearance and equipment to any cars on any street railway in the United States or Canada. They are handsomely lettered and the circuits to which they belong are shown by letter boards on their sides and in front.

CHAS. D. JONES, Superintendent.

The power station which is situated on Union street is used for lighting the town as well as to supply power for the railway. The railway engine which was built in Auburn, N. Y., is expressly designed for street railway work, and capable of withstanding the sudden variations of load incidental to the work. Belted to this engine are two Westinghouse railway generators of 250 horse power each.

As a result of additional plant in the engine room, the company has had to increase its boiler capacity, but owing to the very contracted space, it has had to build two additional stories. On the ground floor is the boiler, and above it the fan and economizer. Three boilers of the locomotive type have been added, and they are expected to do good work as they are very fast steamers and a class of boiler adapted to a station where sudden changes of load cause great fluctuations in demand for steam. The intention is to run the station on the induced draft principle, the first of the kind in the maritime provinces if not in Canada. It does away with a brick chimney altogether. The fan which is used was made in Boston and is capable of handling the gas from a 1200 h. p. boiler. The machine has been placed on the first story above the boiler. The gas will be drawn through a

Green economizer of 320 pipes. On the top of the economizer is an arrangement of gearing for scraping the soot off the pipes. The soot falls into a pit below. The water which enters the economizer at a 100° is heated to 250° before going into the boilers.

The car sheds, situated at Indiantown, are two in number, 150 feet by 65 ft. wide, and 132 by 62 ft. One of them is fitted up for storing cars at night. In this shed is a washing and drying dedepartment where the cars will be cleaned after their day's run. The other shed is fitted up as a repair shop. A boiler will be placed in one of these buildings for heating purposes. As hinted in a foregoing paragraph the old railway in no sense served the needs of the people of St. John, but the road that has just been placed in operation will serve the city so thoroughly that no house will be more than a block away from the line. There are twelve or fifteen new cars, then a number of the old electric cars were repaired and made nearly as good as new. All these have been placed on the track and have been arranged to give a six minute service.

A number of St. John capitalists are laying out a park around Lily Lake, a beautiful sheet of water only a few moments walk from the city. When the park is completed, the St. John railway Co. has promised to extend its track to the lake. With a car running to this lake every few minutes it would be one of the most popular resorts in the vicinity of the city. Then it is intended to extend their line to Fairville, a pretty little suburb a mile out of the city. There is also strong talk of running the cars to Rothesay, nine miles out of town, on the line of the I. C. R. Many prominent business men live at Rothesay during the summer. .

The superintendent of the road is Chas. D. Jones, and the electrician, A. R. Bliss, whose photos appear in connection with this article.

SPARKS.

The Ottawa Electric Street Railway Co., have been petitioned to extend their Bank street line to the village of Billing's Bridge.

Collingwood capitalists are said to be considering the question of forming a company to build an electric street railway in that town.

Messrs. C. E. Harris, superintendent, and Briggs, chief electrician of the Nova Scotia Telephone Co., recently selected a route for a metallic circuit line between Truro and New Glasgow.

The suit brought by the Edison Electric Light Company against Westinghouse, Church, Kerr & Company, for infringement of the feeder and main patent, has been decided in favor of the defendant by Judge Acheson, of the United States Circuit Court of Appeals, at Philadelphia.

Mr. P. R. Randall is at the head of a company which propose to construct an electric railway in Port Hope, and to extend the same to Rice Lake, there making connection with a line of steamers making four trips a day to Peterboro'. The company propose also, to build a branch line to Cobourg.

American capitalists are said to be negotiating for a charter for an electric street railway, at Brockville, Ont. Mr. W. H. Comstock, a well-known citizen, holds a charter for a horse railway; but is said to be willing to dispose of it at a nominal figure, in order to induce the construction of an electric road. The promoters of the new enterprise ask a twenty years' franchise, exemption from taxation, and the privilege of operating their cars every day in the week.

The Quebec City & District Railway Co., is seeking a charter from the Quebec Legislature to construct and operate electric railways in the city of Quebec and adjoining counties. The promoters of the company are: Hon. L. P. Peletier, advocate, of Quebec, M.P.P.; Hon. Phillippe Landry, of Villa Mastai, senator; J. J. T. Fremont, advocate, M.P.; P. B, Eumoulin, banker; Bernard Leonard, painter; John T. Gregory and Earnest Pacaud, the five latter of the city of Quebec.

The syndicate which proposes to construct an electric railway from Hamilto Guelph, is reported to have purchased the Niagara Central Railway, which operates between St. Catharines and Niagara Falls. It is said to be the intention of the purchasers to extend the road to Hamilton, and there make connection with their proposed radial electric lines. At a meeting recently held at Waterdown, of those interested in the Waterdown and Guelph Electric Railway, it was stated that a Boston syndicate are prepared to undertake the construction of the road, and that the only question now to be decided is, what route the line should take out of Hamilton. It is said to be the intention of the promoters to build the road with rails of sufficient weight to carry a freight train of twenty-five cars. Sir W. P. Howland made the statement that the syndicate represented a capital of $50,000,000. A committee was appointed to negotiate a basis of agreement with the company, and to report to a future meeting of the ratepayers.

OPENING OF THE HAMILTON, GRIMSBY AND BEAMSVILLE ELECTRIC RAILWAY.

THE Hamilton, Grimsby and Beamsville Electric Railway, frequent mention of which has been made in the ELECTRICAL NEWS during the period of its construction, was formally opened for traffic on the 17th of October. A large number of invited guests participated in the opening ceremonies. The company and invited guests embarked at the Hamilton end of the line at two o'clock p.m., and were conveyed to Grimsby, stopping en route at Stoney Creek to inspect the power station and its equipment. At Grimsby a tempting luncheon was enjoyed, following which came a number of speeches in which well-deserved praise was bestowed upon the enterprise of the company and the creditable manner in which they have carried out their undertaking. All were delighted with the beauty of the scenery through which the line passes. We present portraits of Mr. F. E. Handy, under whose superintendence the road was constructed, and Mr. Clyde K. Green, who has been appointed to succeed him as electrician for the Company. It should be mentioned that Mr. Handy is about to make a visit to Europe. Mr. Green is a young man, who, after finishing a college course, accepted a position with the Edison Co. at Peterboro'. He continued with the Canadian General Electric Co. after the amalgamation of the Edison and Thomson-Houston interests. On the opening of the Toronto Street Railway he transferred his services to them, and was in their employ until last September, when he received the appointment to his present position. The following particulars of the road, with the electrical supervision of which he has been entrusted, will doubtless prove interesting :—

F. E. HANDY, Superintendent of Construction.

POWER HOUSE.

The building is a substantial brick and stone structure, 40x95 feet in size, and standing back from the main street just east of the bridge at Stoney Creek. The boiler room, which is 30x40 feet, contains two 200 h. p. tubular boilers, with room for a third. The flues of these boilers are so constructed as to utilize all the heat possible from the coal consumed, and are bricked over, allowing room for the smoke after leaving the tubes to pass between the shell and brickwork back to the chimney flue. Mr. McFarlane, engineer of the Hamilton Water Works, by request of the Company, put in the steam plant. The first thing that meets the eye on coming to the engine room is the switchboard, which for the size of the plant, cannot be beaten in America. It has a full set of instruments for each generator, all mounted on marble slabs, and these placed on another large marble board 7x8 feet in size. The arrangement of this switchboard reflects credit on the electrician. Right here the line is divided and separate bus bars are put in for east and west. The following instruments adorn the switchboard: Two 3-jaw switches, four automatic circuit breakers (two of these for feeders instead of the old-time fuse), two generator ammeters and one main line ammeter; two voltmeters (one portable), two single jaw switches for feeders and trolley, two generator lightning arresters, and two Wurtz arresters. The whole of these instruments were supplied by Messrs. Ahearn & Soper, of Ottawa.

Two Westinghouse generators, capacity 150 h. p., 225 amp. multipolar, supply the current, being belted to two 150 h. p. Corliss condensing engines, supplied by Messrs. John Inglis & Son, Toronto. One of these units is enough for the traffic during nine months of the year, but on account of the heavy Grimsby Park business during the remaining three months, July, August and September, both engines and generators will have to be in operation.

Water for condensing is found in a pond 15 feet deep and 60 x120 feet in size, situated some 20 feet west of the power house. Two car wheels are grounded in the pond and connected to minus bus bars and station arresters. The leads, trolley feed and tracks are strung over rafters in the building and through a perforated block of stone in front of the building, then branch off east and west along the line. A substantial brick chimney, 100 feet high, towers up at the rear of the building.

CAR BARN.

This building is of brick, 50x130 ft. Being situated at Grimsby, it allows for an early car leaving the barn to bring passengers and milk to Hamilton by 6:30 a.m., insuring a much quicker delivery to the city than the present mode. There are three tracks in the barn, one with a pit nearly the entire length for cleaning and repairs to motors. At the west end of the building is a large store room and machine shop 15x40 ft., where a motor will be installed to operate lathe, drill, etc.

CARS.

Eleven cars constitute the first equipment of rolling stock. They comprise five trolley cars, four 32 ft. and one 28 ft. bodies, with double McGuire trucks, and one single McGuire truck—all having Westinghouse motors of the latest design (30 h.p.) Controllers are the new series multiple type. There are four freight cars and two very fine open cars, probably the longest in Canada. All the cars were built by the Ottawa Car Co.

CLYDE K. GREEN, Electrician.

THE LINE

is 16½ miles long, with six turnouts or switches, and several stubs blind sidings for the freight cars. The trolley wire is No. 0 B. & S., with 14 miles of 0000 feeder. A metallic return of No. 10 copper, telephone system, is also installed. All bells and clips, strain holder insulators, etc., were made by Ahearn & Soper. The brackets, made in Hamilton, are on the iron pipe principle, screwed into ½ inch boiler plate, which is bolted to the pole. The poles are 28 feet long, and all well tamped into six feet of ground. One feature of this line is the number of slight curves, necessitating a large number of stubs and guy poles.

THE TRACKS.

are of the above length at present, but arrangements are in progress to run them to Grimsby Park and Beamsville in the spring, which will make the entire line 28 miles. Rails are mostly of the pattern weighing 50 lbs. to the yard, but in the centre of Stoney Creek and in Hamilton city limits, 86 lb. girder rails were called for. These rails are bonded with No. 0 copper, and cross bonded every fifth rail with same size copper. The ferrule cap style of bonding has been exclusively employed.

Messrs. Wm. Stewart & Son, architects, of Hamilton, designed the buildings; Messrs. Myles, the Civil Engineering; the whole of the electrical equipment of the road being in the hands of Mr. F. E. Handy, Electrical Engineer, late of the Vancouver, B. C., Westminster and Vancouver Tramway.

Trouble is very often experienced with Corliss valves pounding by the breakage of the springs that hold the valve to its seat, says the Boston Journal of Commerce. When this occurs a clicking noise is heard that is very disagreeable to the engineer who wants everything to run quietly. An engineer who was troubled with these springs breaking was induced to change the character of the spring. Instead of using brass spring wire, similar to that found in the engine, he tried a steel piano wire of good quality, and to prevent rusting had it nickled when it was cut to the right size. The spring was cut longer than needed, and put into a vice and compressed coil to coil to give it all the set it would ever have. The springs have given no trouble since.

SPARKS.

The increasing use of bicycles is said to be making serious inroads on the receipts of electric street railways in Montreal, Toronto and other cities.

The Montreal Street Railway Co. show a surplus for the year ending September 30th last, of $37,354.46. A half-yearly dividend of four per cent. has been declared, payable on the 8th inst.

The Galt and Preston electric railway has proved so successful that application is to be made to the legislature for authority to increase the capital stock of the company from $50,000 to $100,000, the object being to extend the road to Hespeler. The company is said to be now making a profit of about $50 per day.

An offer is said to have been made to the Winnipeg City Council by prominent officials of the Toronto and Montreal Street Railway Companies for the erection of extensive gas works in return for certain concessions. The extension of the Winnipeg street railway system to Armstrong Point, a residential suburb, is also said to be under consideration.

Ottawa and Brockville capitalists are said to have decided upon the construction of an electric railway to connect these cities. It is said that the headquarters of the company will be in Ottawa. and that water power from the Chaudiere and Rideau river will be employed for the operation of the road to a point twenty-five miles from Brockville, and that for the balance of the distance, steam power will be used.

It is reported that the Toronto & Scarboro Electric Railway Co. have transferred the control of their road to the Toronto Street Railway Co., accepting as payment shares in the latter company, The Scarboro road is said to have come short of paying expenses. Should the transfer take place it is said to be the intention of the Toronto Railway Co. to complete the line to Victoria Park and carry passengers to the park at single fare.

A charter has been granted to the Packard Electric Co., Ltd., with a capital of $300,000. The following is a list of the incorporators: W. D. Packard, J. W. Packard, Jno. H. Howry, H. K. Howry, Chas. C. Paige, A. Mackenzie and Chas. L. D. Sims. It is the intention of the company to go into the manufacture of electrical apparatus and machinery, as well as incandescent lamps. They have not yet decided upon a location for their works.

From the annual report of the Commissioners of Queen Victoria Park, Niagara Falls, for the year 1893, it is learned that the number of people who entered the park during that year, was 543,924 as compared with 233,495 in 1892. The great increase is attributed to the Niagara Falls Park and River Railway which carried in seven months of 1893 over 400,000 passengers. It is somewhat peculiar that the carriage traffic has also increased since the electric road went into operation.

The City Council of Hull, Que., has granted a charter to a local company represented by Mr. Theo. Viau for the construction of an electric railway and for the supply of electric light. The charter, which is an exclusive one, is for thirty years. The plant, buildings and revenue of the company is to be exempt from taxation for the period of fifteen years. The company is bound to commence the building of the railway in the city of Hull, and radiating to Ironsides, Aylmer and Gatineau Point, within three years; and it is understood that a regular service will be provided seven days in the week.

Four years ago the right to build and operate an electric railway in Ottawa was going a-begging. There were few who were daring enough to believe that it was an enterprise that gave a reasonable expectation of profitable investment. The result, however, is that it has paid a handsome dividend from the start, but not greater than the enterprising gentlemen who made the venture are fairly entitled to. The road is controlled by the firm of expert electricians, Messrs. Ahearn & Soper, who built and equipped it. and it is recognized wherever electric railways are mentioned as a model of its kind. It was the pioneer electric railway of any mention in Canada, and its management were the first to demonstrate the practicability of giving an uninterrupted service throughout the winter season. Since in the remote past, the building of the Rideau locks, there have been two distinct eras in the progress of Ottawa: one its selection for the seat of government, the other the construction of the electric railway.—Montreal Hetald.

MOONLIGHT SCHEDULE FOR NOVEMBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	
1......	P. M. 6.10	A. M. 5.50	11.40
2......	″ 7.10	″ 5.50	10.40
3......	″ 8.20	″ 5.50	9.30
4......	″ 9.40	″ 6.00	8.20
5......	″ 10.30	″ 6.00	7.30
6......	″ 11.40	″ 6.00	6.20
7......	....	″ 6.00	5.00
8	A. M. 1.00	....	
9......	″ 1.40	″ 6.00	4.20
10......	″ 2.10	″ 6.00	3.50
11......	″ 3.10	″ 6.00	2.50
12......	″ 4.00	″ 6.00	2.00
13......	No light.	No light.	....
14......	No light.	No light.	....
15......	No light.	No light.	....
16......	P. M. 5.20	P. M. 8.50	3.30
17......	″ 5.20	″ 9.50	4.30
18......	″ 5.20	″ 11.10	5.50
19......	″ 5.20	A. M. 12.10	6.50
20	″ 5.20	″ 1.10	7.50
21......	″ 5.20	″ 2.10	8.50
22......	″ 5.20	″ 3.20	10.00
23......	″ 5.20	″ 4.30	11.10
24......	″ 5.20	″ 5.40	12.20
25	″ 5.10	″ 6.10	13.00
26......	″ 5.10	″ 6.10	13.00
27......	″ 5.10	″ 6.10	13.00
28......	″ 5.10	″ 6.20	13.10
29......	″ 5.10	″ 6.20	13.10
30......	″ 6.30	″ 6.20	11.50
		Total,	220.00

CANADIAN GENERAL ELECTRIC CO.
(LIMITED)

HEAD OFFICE
65 TO 71 FRONT STREET WEST
TORONTO, ONT.

BRANCH OFFICES
1802 Notre Dame St., Montreal; 50 Main St., Winnipeg; 138 Hollis St., Halifax; Granville St., Vancouver.

TORONTO, Oct. 26th, 1894.

DEAR SIRS :—

Having by the removal of our Lamp Manufacturing business to Peterboro', consolidated this Department with our other manufacturing interests, we have been able to materially reduce the cost of production and at the same time improve the quality of our lamps, which are now the best on the market.

We have decided to give our customers the full benefit of this reduction, and will therefore from this date supply our INCANDESCENT LAMPS in not less than barrel lots at the following prices, viz. :

16	**c. p. Lamps,**	**25**	**Cents**	**each net**
24	"	**30**	"	"
32	"	**35**	"	"

Five Cents per Lamp extra when ordered in less than 100 lots.

With many thanks for past favors,

Yours very truly,

THE CANADIAN GENERAL ELECTRIC CO.
LIMITED.

SPARKS.

The demand for mica has lately increased to such an extent that Canadian mica properties are changing hands at high figures.

The Petrolea Light, Heat & Power Co., has been incorporated with a capital stock of $25,000, and the London Electric Co., with a capital stock of $250,000.

Mr. Griffith, manager of the Hamilton Street Railway, who has just returned from the street railway convention at Atlanta, Ga., states that he saw nothing in the line of street railway fenders at the exhibition there, which was equal to those in use in Toronto.

Application for incorporation is being made by the Central Telephone Co., of Bridgewater, N. S. The object is to construct a telephone line between Bridgewater and adjacent towns. Mr. Nelson P. Freeman, of New Germany, is one of the promoters of the company.

The Ottawa Electric Light Co., which embraces the Standard Electric Co., and the Chaudiere Electric Co., owns four water power houses and one steam power house. The steam plant is seldom used. The dynamos in these several power stations have a combined capacity of 35,000 incandescent lights, and 500 arc lights.

$100,000 has been voted by the citizens of Vancouver, B. C., for the purchase of a municipal lighting plant. The Victoria Colonist, makes the following significant comment: "On the principle that 'misery loves company,' we should feel rather pleased that the corporation of Vancouver have obtained authority from the ratepayers to do the lighting of their city."

Mr. Frederick W. Mount, electrician with the St. John, N. B., Gas Light Co., committed suicide, by shooting himself through the heart with a revolver, on the 5th of October. Deceased was forty years of age, and a native of Montreal. Despondency, induced by some difficulty with machinery, is believed to have been the cause of the unfortunate occurrence.

Messrs. R. & W. Conroy, of Deschene Mills, Que., have had installed at their mills, an electric plant, by means of which power is to be transmitted for cutting corn and other farm purposes, to their farm buildings a mile distant. Their creamery plant is also to be operated by electricity, and is said to be the first plant of this description to be operated in this manner. The Messrs. Conroy control a water power of about 10,000 H. P.

Following the voting down of a by-law by the citizens of Summerside, P. E. I., to purchase a municipal lighting plant, has come the formation of the Summerside Electric Light, Heat & Power Co., Limited, with a capital stock of $10,000. The company has ordered from the Canadian General Electric Co., the necessary plant for 1,000 lights, and expects to have them in operation about the 15th of December. The officers of the company are as follows: T. B. Grady, president; R. T. Holman, Neil McQuarrie, Neil McKelvie, Neil McLeod, Leonard Nevin, H. W. B. Stewart.

Mr. George Johnson, Dominion Statiitician, in a report on the subject of lighting in Canada, states: Electricity has been given a commanding position, and though gas works have increased from 36 in 1881 to 49 in 1891 and their continued value to the wage-earner is seen in the fact that 1,164 hands were employed in 1891 against 1,062 in 1881, yet against the two employed returned in 1881 as connected with electricity there were 1,190 wage earners in 1891. Electricity as a motive power has been adopted by thirty companies, having 256 miles of railway thus operated. This development has its influence upon other industries, such as street car building, and any industries in connection with iron and steel, etc.

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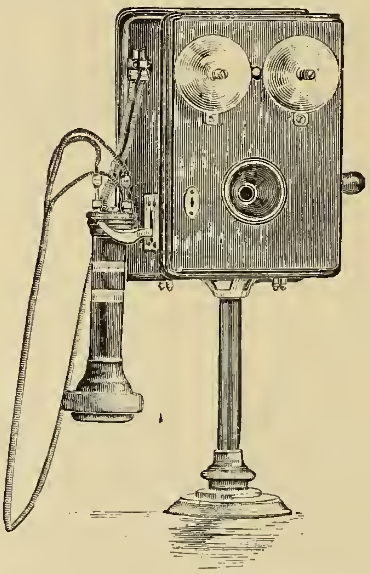

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SPARKS.

A Winnipeg motorman, named McLaren, recently fell heir to an estate worth $20,000.

Mr. O. N. Auge, has been elected President, Mr. Wm. Clendinneng, Vice-President, and Mr. A. Prieur, Secretary, of the Montreal Island Belt Line Railway Co.

Application will be made to the legislature of Quebec, for authority to increase the capital stock and enlarge the scope of operations of the Montmorency Power Co., Montmorency, Que.

The Montreal City Council will apply to the legislature for a number of amendments to the city charter, among others, for authority to regulate the tax on telegraph, telephone, electric poles and wires, and the apparatus pertaining thereto.

The Colonial Telegraph & Telephone Co. have been granted a charter to operate and maintain telegraph and telephone offices in Canada. The capital stock is $25,000, and the incorporators are all Americans, except two, who reside in Niagara, Ont.

Mr. A. V. White, of the Canadian General Electric Co., is delivering a series of lectures in the Mechanics' Institute, at Peterboro', on "Elementary Mechanics," "Mensuration," "Machine Design," and "Electricity." The lectures are being well attended.

The St. Thomas Street Railway Co., will ask the council for a franchise to light the city, and for commutation of taxes. The company state that it would be impossible to successfully operate an electric railway unless they are given the exclusive right to furnish all the electricity that may be required for any purpose.

On the morning of the 18th of October, the large dam, 250 feet long, and 35 feet high, at Cobden, Ont., gave way. The new electric power house and incandescent lighting plant which had just been got ready to go into operation, owned by Mr. Alexander McLaren, was swept away, resulting in a loss of about $9,000. The night watchman who was in the station at the time of the accident, was carried out into the lake, two miles distant, but miraculously escaped with his life.

Incorporation has been applied for by the Buckingham Electric Railway, Light & Power Co., to build a railway from the mouth of Du Lievre, to Buckingham village, in the Province of Quebec, and to carry on a general electrical business. The applicants are: Albert McLaren, of the town of Buchingham, gentleman; Thomas Kennedy, of the city of Ottawa, agent; E. S. Leetham, of the city of Ottawa, agent; Thomas Wells, of the town of Buckingham, aforesaid, superintendent, and Henry Aylon, advocate, of the town of Aylmer in the district of Ottawa.

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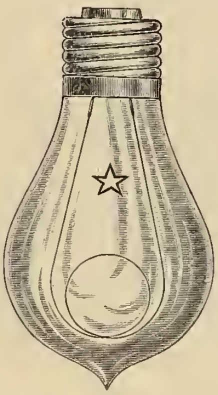

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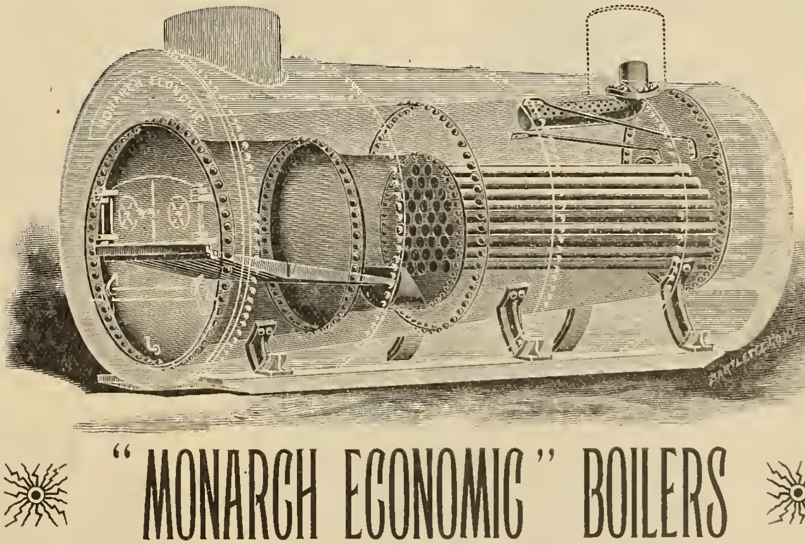

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SPARKS.

The recent health congress at Montreal, recommended the thorough cleaning of floors and cushions of cars.

Under a by-law of the City Council, the Toronto Street Railway Co., are under obligation to vestibule their cars on lines of most traffic before the 1st of December next, and on the remaining lines before the 1st of February, 1895.

The South Shore Electric Co., is applying for incorporation with a capital of $25,000. The applicants are: Hon. Louis Tourville, of Montreal, lumberman; Andrew Hardie, of Longueuil, farmer; William B. Powell, of St. Lambert, manager; Henry Williams, of St. Lambert, secretary; Joseph Horsfall, of St. Lambert, merchant; Fred. Thomson, of Montreal, electrician, and George F. Burnett, of Montreal, insurance manager.

The Toronto Globe is responsible for the following: An instance of how the rural population receive information regarding our city was witnessed in the tower of the Parliament buildings the other day. A young man evidently a farmer, who had been in the city for a few days, was showing a young lady the sights. Pointing to the iron framework of the gas tanks, he asked her if she was aware of the use they were put to. She replied in the negative. "Well," he said, "in them iron scantlings is big tanks, full of electricity, and it lights the whole city." He had evidently been told that it was a city lighting plant, and imagined that the deadly fluid was contained in the giant reservoirs.

The Bell Telephone Company's Exchange, at Kingston, Ont., has been undergoing repairs for several months past. The exchange is located in the Hotel Frontenac Block, the entrance from Ontario street leading into a large and cheerful public office and waiting room. Adjoining is the office of the Manager, Mr. A. T. Smith, and next to this the distributing room, on one side of which is the switchboard composed of twelve sections. Each section is capable of serving fifty subscribers. A daily average of over 3,500 connections are made. Adjoining the operating room are dressing rooms, lavatories, and storerooms. The staff consists of six day and one night operator, one messenger and two repairers. Mr. Smith, the local manager, is entitled to credit for the completeness with which the improvements have have been carried out.

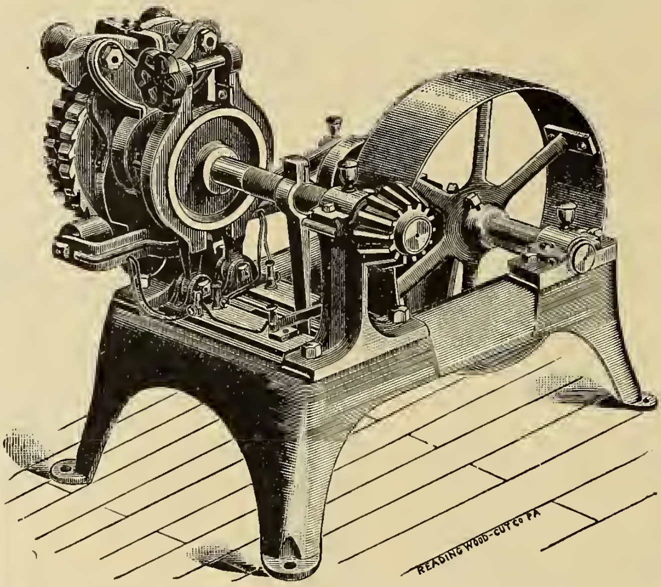
Incorporation has been granted to the Seaforth Electric Light, Heat & Power Co,, with a capital stock of $25,000.

The right to use the immense water power of McCool's mill, at Mattawa, Ont., has been purchased by the Mattawa Electric Light, Heat & Power Co.

Application is being made for incorporation by the Electrical Chronometer Co., of Toronto, to manufacture time indicators, etc. The capital stock is $100,000.

The St. Thomas Street Railway has lately been purchased by the syndicate who control the Cleveland, Toronto and London systems. Mr. E. R. Cameron of London, has been elected president, and Mr. John Break, of Toronto, secretary-treasurer of the new company. If a satisfactory arrangement can be made with the Council, the system will be transformed to an electric one in the spring.

The Town Council of Kincardine recently bought from Messrs. Henry & Swan their Ball arc electric light plant for the sum of $2,350 the purchase to include the free use of seven sixteen candle power incandescent lamps for three years. At a special meeting of the Council recently, the committee which had charge of securing tenders for the incandescent electric light system reported. The Canadian General Electric Co.'s figures were $3,343.20, for the work complete, which includes dynamos for incandescent light, poles, wiring, etc. The company were given the contract. For the engine, Inglis & Son, of Toronto, tendered at $1,625 for a Corliss engine, everything complete. This was also accepted. The town council also recently purchased the waterworks for the sum of $40,000. The various plants will be put in one power house and run under the superintendence of Mr. Jos. H. Walker, who has been engaged at an annual salary of $1,100, he to find his own assistants.



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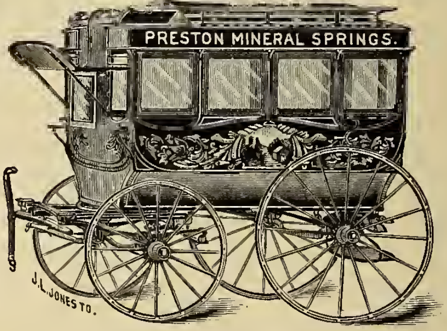
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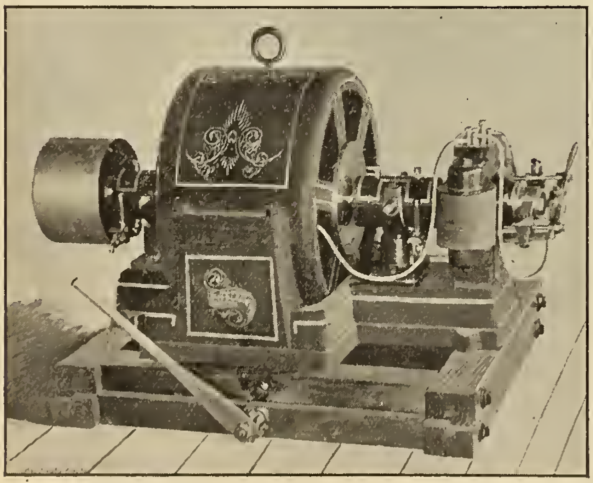

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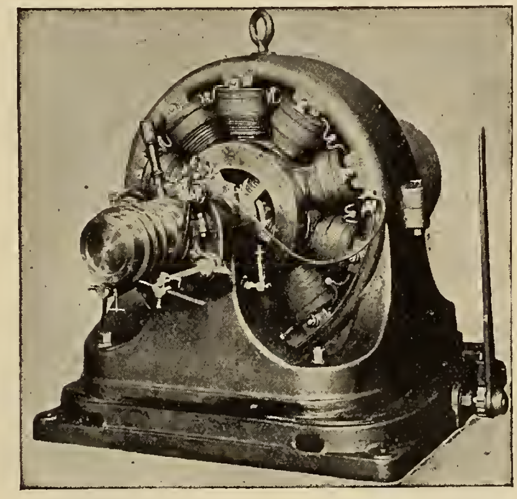

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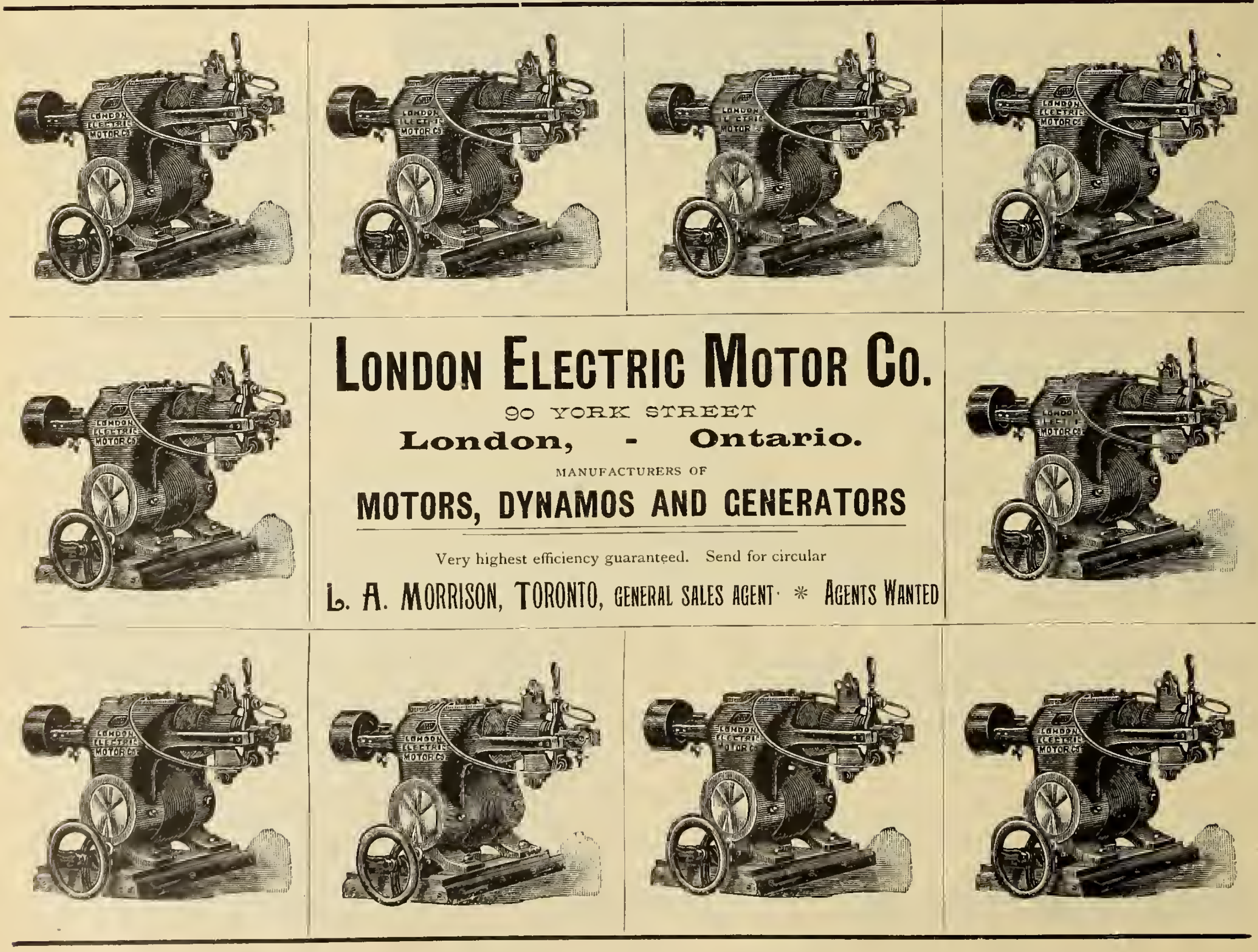

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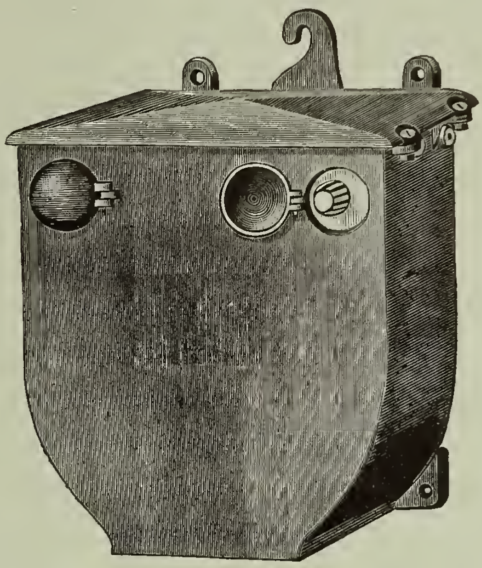

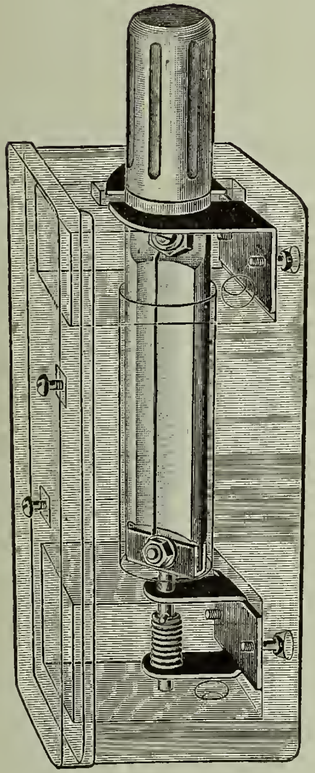

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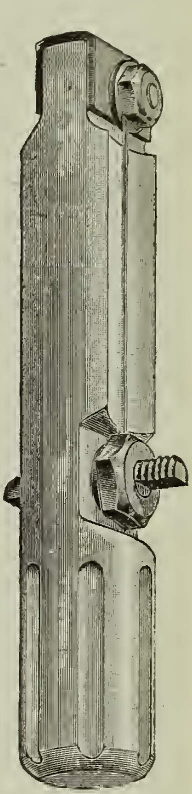

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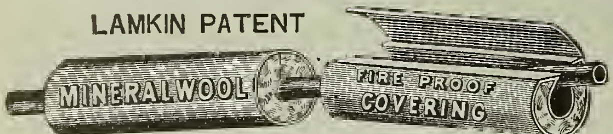

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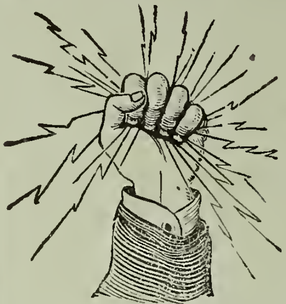

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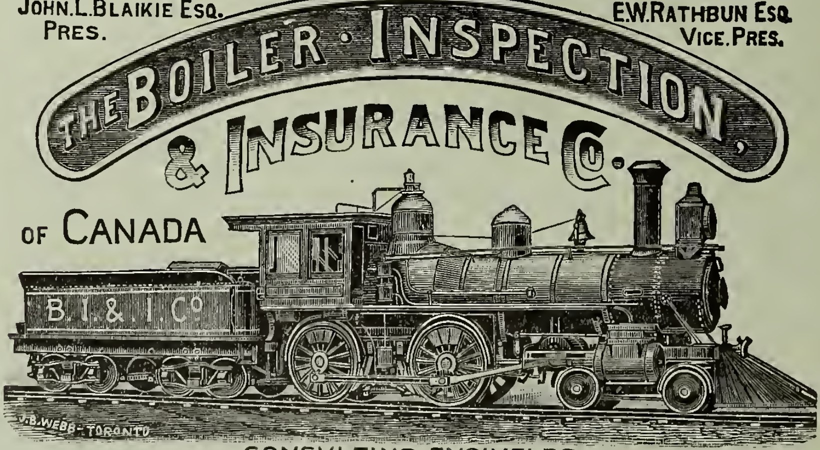
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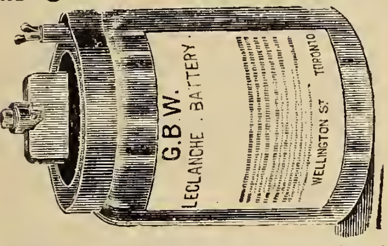

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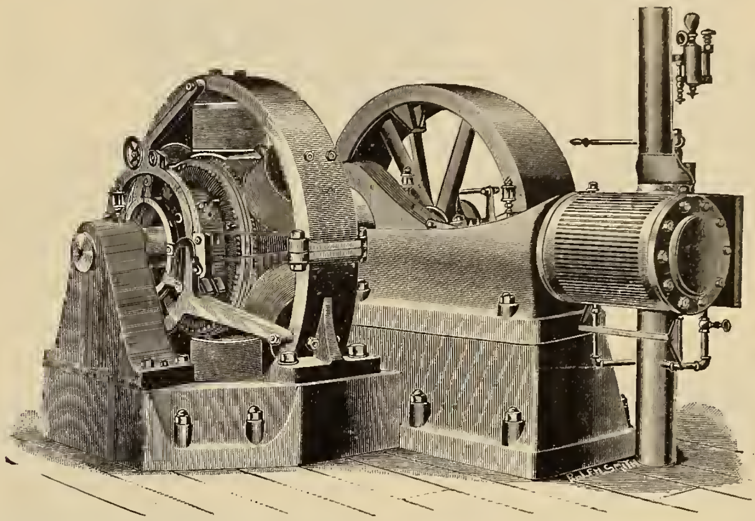

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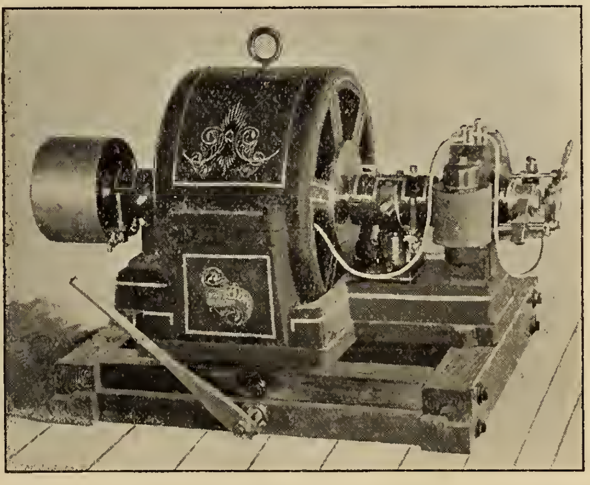

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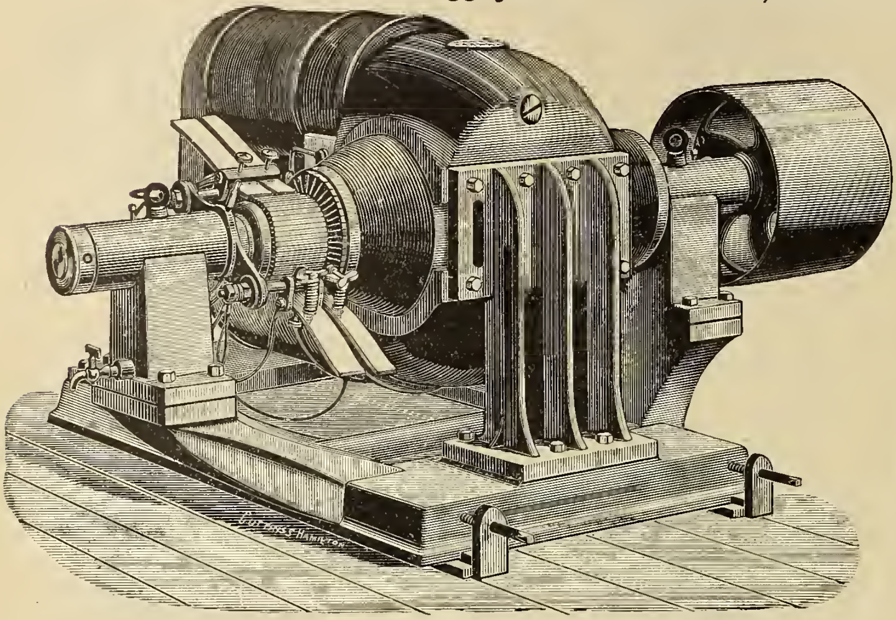

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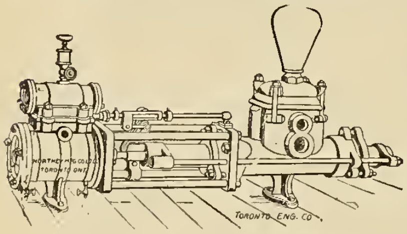
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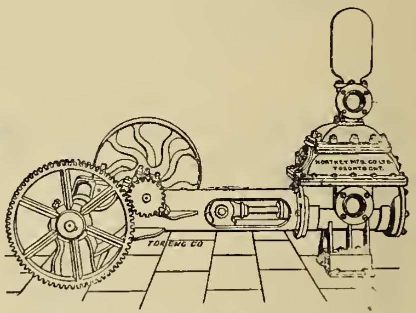

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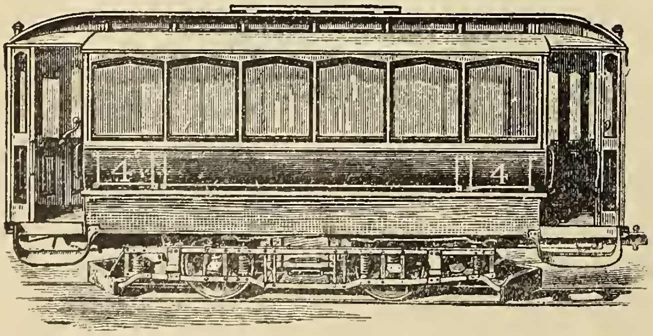

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CANADIAN

ELECTRICAL NEWS

AND

STEAM ENGINEERING JOURNAL.

VOL. IV. DECEMBER, 1894 NO. 12.

MR. GRANVILLE C. CUNNINGHAM.

IT affords us pleasure to reproduce from a recent number of the New York Electrical Review, the accompanying portrait and sketch of Mr. Granville C. Cunningham, manager of the Montreal Street Railway:—

Mr. Granville C. Cunningham, of Montreal, P. Q., who was elected a member of the Executive Committee of the American Street Railway Association, at the recent Atlanta convention, learned the profession of civil engineering in Edinburgh, Scotland. After having been engaged in various railway works and other enterprises in the old country, he left his native land in 1870 and went to Honduras in Central America, where he had charge of part of the surveys of a trans-continental railway that was then projected. The outbreak of war between Honduras and San Salvador brought this enterprise to an untimely end, and in 1871 Mr. Cunningham came to Canada. Since then his work has connected him with many of the chief railway schemes of that country. Subsequently he turned his attention to railway law, with the purpose of giving up the engineering profession, and for two years lived at St. Thomas, Ont., as the resident solicitor of the Canada Southern Railway. In 1882, however, he was appointed chief engineer of that line, which position he held until its amalgamation with the Michigan Central. He then took up contracting and built the double track branch of the Michigan Central, from Welland to Niagara Falls, in connection with the great cantilever bridge across the Niagara gorge, which work was finished in the end of 1883. In 1884 and 1885, two years were spent on the Rocky Mountain division of the C. P. R. as assistant to the manager of construction, including the winter spent at the summit of the Selkirks for the purpose of observing the snow slides and designing snow sheds—an occupation of no small danger. After this he was again a contractor, and in 1887 and 1889 carried out contracts for the construction for part of the Temiscouata line near Riviere du Loup, and of the C. P. R. short line near Sherbrooke. In 1889 Mr. Cunningham was appointed assistant city engineer and afterwards city engineer of Toronto. Here his attention was directed to electric street railway matters, and it was on the report made by him to the City Council of Toronto that the system now in operation there was adopted. In 1892 he was appointed chief engineer of the Montreal street railway, and the work of converting this from a horse to an electric system has been carried out under his direction. He was appointed manager and chief engineer of the Montreal street railway. In 1878 Mr. Cunningham was elected a member of the Institute of Civil Engineers of London, and has contributed papers to the tranactions of that society, notably one describing the construction work on the C. P. R. in the Rocky Mountains, which was separately published by the society, with cognate papers in pamphlet form. He was also among the first members of the Canadian Society of Civil Engineers and was recently elected a fellow of the Royal Colonial Society of England.

MR. GRANVILLE C. CUNNINGHAM.

VALUE OF A VALVE RE-SEATING MACHINE.

One of the little things which is bound to pay its way in a steam plant of any magnitude, says Power, is a valve reseating machine. In the first place it makes a great reduction in the loss by leakage, a loss which becomes very considerable when in addition to the heat units discharged by the escaping fluid is added the destruction of pipe coverings, corrosion, and deterioration of the surrounding work which is apt to result from a neglected leak. If the valve can be repaired in situ, it will be attended to promptly. If it must be taken out, an opportunity must be awaited when the engineer has time for an extended and perhaps difficult job and the system can be shut off long enough to permit of its being done. Again, there is the saving of the time of the engineer or pipe fitter, usually overtime at an increased rate of payment; and finally there is the saving in valves, fittings and coverings, for usually some of these will be sacrificed in taking down the piping necessary to get a valve out, a new valve will be put in to save time, and the leaky one will find its way to the scrap heap.

CONCERNING DASH POTS.

The dash pots used in connection with the valve gear of many engines do not receive the care and attention they require in order that they shall perform their function in a proper manner. Indicator diagrams taken from such engines as have been in use a few months without the indicator being used upon them, show almost invariably that the dash pots have become leaky or at least do not produce the quick closing of the valves for which they are intended. On many dash pots, says an exchange, petcocks have been attached which, by being partly open or otherwise adjusted, reduce the clicking noise made each time they operate. The way these are ordinarily adjusted makes it questionable as to their utility, and it would be much more advantageous to the engine and economical of fuel, if the noise was retained and, at the same time, the valves would close with the intended rapidity. The slow closing of an ordinary slide valve is one of the detrimental features inseparable from this device and the utility of the releasing gear on higher class engines is often greatly reduced for this reason. The care of the dash pots employed in connection with the releasing gear requires fully as close attention as does the piston packing of the engine, or material used for the same purpose in a pump. A good vacuum is necessary in the dash pots to produce quick closure of the valves, and unless the packing is kept in good order the leakage which follows excessive wear, or any looseness, will reduce the quick action on which the success of that valve gear depends.

In observing a number of engines employing this device, a great difference in the rapidity of their action will be observed, for in some it will be noticed that the action is more rapid than the eye can follow, while in others a logy motion is observed that speaks ill for the utility of the device, and is a sure indication that considerable less than the best results are obtained from the use of the steam. Engineers in charge of engines having dash pots as a part of the valve gear should make themselves as familiar with the details of construction and operation of the device as they are accustomed to with other parts of the engine, with that of pumps or other apparatus employed in the steam plant and, it is needless to say, that best results can be obtained only when each detail of the plant is in the best possible condition.

When fitting up an engine shaft or other large shaft, in fact, jack shafts or similar work, it is a good plan to allow a little end play in the shaft as it distributes the oil and makes the bearing much smoother and better, says an exchange. This will often cure a shaft that has been heating and giving trouble, and in a new shaft particularly it is best to do this.

A new belt fastener recently patented in England consists of a metal plate adapted to extend across the meeting edges, the plate having one straight side and at the other side a series of spurs arranged in pairs longitudinally opposite, the spurs of each pair being at equidistant points from the transverse center of the plate and arranged in advance of the preceding pair in both directions, so that each pair will penetrate the belt at different points.

CENTRAL STATION TYPES.

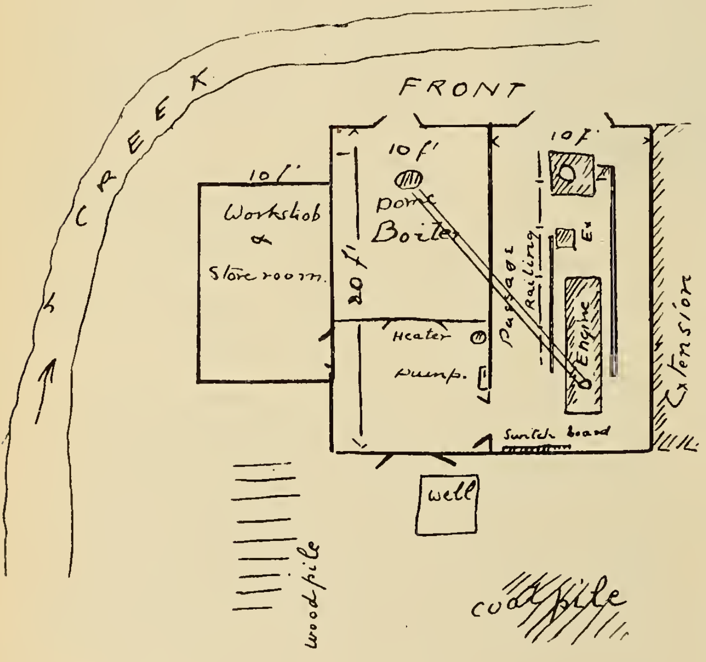
By Geo. White-Fraser

NO. 1—SMALL PRIVATE LIGHTING PLANT.

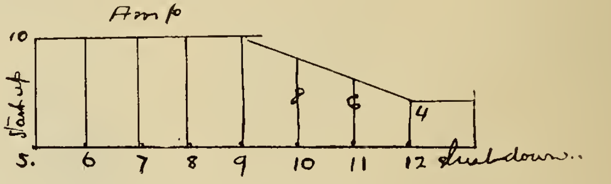
IT has been suggested to the writer that a series of articles on the progress of electric lighting and railways in Western Canada would be of great general interest; and that if certain typical stations, selected carefully as possessing features of special value, were fully described, professional men throughout Canada, and more especially managers of small plants, might be able to benefit greatly by seeing what is done by other managers endeavoring to approximate towards perfection of service and economy; and so by calling attention to the special features in the various types whereby some particular advantage is gained, the general efficiency of management throughout the country may be raised, to the benefit of the electric lighting and railway interests generally.

It might be supposed that a careful description, in detail, of one of the large central stations—Montreal, Toronto, or Hamilton—would cover the entire field, and that small stations might profitably base their practice on that obtaining among their more wealthy brethren; and so indeed they can, but a little consideration will show that their conditions are greatly different, and in some respects their problems more difficult of satisfactory solution. The business of a large station is sufficient to allow of high salaries being paid to really scientific engineers, and the services of thoroughly skilled men are engaged throughout; intricate tests being continually made, requiring delicate instruments; and generally a refinement of efficiency and consequent economy is aimed at, quite beyond the reach of the manager of a station in a town of perhaps 3,000 inhabitants. The first principles, however, of design, construction and operation, are common to small and great, and the more carefully these are attended to and carried into effect, the better will be the prospects of future satisfactory results. The more generally it is understood that an electric lighting or railway enterprise is a thing to be seriously considered, and every successive step carefully taken, and every side issue cautiously weighed, the better for the entire electrical industry. Electricity is too often thought to be a subject that every ordinarily intelligent person can handle, and hence we find electrical enterprises placed under the charge of quite inexperienced men, the inevitably disastrous results being chalked up to the debit of electricity itself. It is the purpose of the writer to select various central stations, as types of a class. 1. The small plant in a town of 2,000 inhabitants, under private ownership. 2. The same with municipal ownership in connection with other municipal works. 3. Same in large town of 20,000, private ownership. 4. Small railway plant, with or without lighting business; and to conclude with careful description of a large city plant, railway and lighting. It is hoped that this may lead to an interchange of ideas on central station management that will be of great benefit.

Before proceeding with Type No. 1, the writer will briefly refer to one small plant with which he has recently been connected in an advisory capacity, the name of which is, for obvious reasons, not given. The plant presents an example of "How not to do it." The machinery was started in Oct., '91. Everything looked well—commutator nicely polished and lamps giving more than rated illumination. No consulting engineer having been engaged for preliminaries, it was shortly evident that the engine was not right, discovered to be "not sufficiently powerful," and consequently thrown out, it having in the meantime developed a bent shaft. As an incident having apparently no connection with this misfortune, it was mentioned to the writer that the only steam employee was a "fireman" (!). Another engine was purchased, presumably on this fireman's recommendation, the regulation of which is so delightfully uncertain that not only has the voltage needle an irregular swing, but the speed decreases at the end of every stroke. The only "electrician" in connection with the plant is one whom the authorities honestly called a lineman! The dynamo is out of date, and has a system of excitation that no college student would endorse. The transformers are of three different makes and unascertainable efficiency, and were installed without any reference whatever to the dynamo periodicity; no tests were ever made as to economy or efficiency, and great indignation was expressed when the plant didn't even pay interest on investment. The poor lamps were burning at all kinds of voltages, and the whole affair rapidly falling into innocuous desuetude. Reasons were not far to seek. No professional advice was obtained, the cheapest plant was bought, quite inexperienced men employed to run it--hence the result. As a great contrast to the above, the little town of Aurora presents an example of a little plant where the conditions have been carefully studied, and a result worked out, whereby a minimum of present expense has secured quite sufficient for present lighting requirements; and possible future extensions have been kept well in view, so that when they become necessary, additions can from time be conveniently made, without in any way disarranging the present plant.



Aurora possesses a population of almost 2,000. There are the usual stores of all kinds, hotels, stables, private houses; altogether a very compact little place. In April, '94, Mr. W. D. Murray, the owner and superintendent, started up with one 500 light alternator, made by the Royal Electric Co., that being considered sufficient for a start. Reference to the diagram will show the arrangement of machinery. The building is 20 × 30; brick walls and shingle roof; and is so divided that sufficient space is given, and not too much. The coal and wood piles are so situated as to be quite near the boiler room door; the well at this door is fed from the little creek, and the pump lifts water from it and forces it through the exhaust steam heater into the boiler. The workshop is fitted with bench and shelves, and here are kept all the stores, wire, lamps, etc., and oil. The man in charge stands at the door by the switchboard, from which position he can watch his indicators, steam and water gauges, and has everything under his eye. The particular feature of this whole arrangement is that engine, dynamo and boiler constitute one unit, very compactly placed; if the lighting requirements grow sufficiently to justify the purchase of another 500 light dynamo, another such unit of engine, dynamo and boiler of same sizes will be installed; a small 10 × 30 extension will be built on where the shaded part marked "extension" is seen, which will contain the engine and dynamo, and another boiler will be added in the workshop, which can readily be adapted. By this design no capital is wasted. Boiler setting is ordinary brick, and engine foundations consist of a course of good building stone, solidly laid, 3 feet thick, with 3 feet of brick on top of that, coming level with the floor. Piping is covered with asbestos, and comes directly across, with no bends, to the engine. The dynamo is the usual ordinary alternating dynamo, giving 1040 volts on the primaries, and separately excited, all switches being on the switch-board, where are also the usual instruments and indicators. There is nothing special about the lines, except that in one or two central spots are placed transformers of comparatively large capacity, and from these are led secondary mains from which are tapped off the service wires to the house and store lamps. Transformers give 104 volts on the secondary, and by the use of a few large transformers supplying secondary mains, instead of installing small transformers for each group of lamps, a reduction of first cost and of electrical efficiency is obtained, large transformers being more efficient and costing less per light than small ones. The lighting of houses, &c., is by 16 c.p. lamps of 104 volts, and a number of incandescent lamps are placed in the streets, on the well-known "street system." This latter seems to present some advantages worthy of consideration. A small town like Aurora does not require a great deal of street lighting, so that if arcs were used it would mean a quite small machine and extra space and more attention, which can all be given equally satisfactorily as far as results go, to one dynamo combining both street and private lighting. In a small plant it is quite an object to minimize handling of apparatus, as well as to make a little capital outlay go a long way, and both these objects seem to be attained by the installation of the alternating street lighting system. The conditions obtaining in Aurora itself seem particularly favorable to this system, as, on account of the street lighting contract calling for the shutting off of the lights at midnight, and that being also the time for the shutting down of the entire plant; while the plant is actually running, it is always running on a reasonably large percentage of its rated capacity. The policy of the town in shutting off its lights at this hour is beyond the scope of this article, but its advantage to the plant is obvious. This installation of street system is probably of use in keeping the load line so fairly even during the hours of service as it is. The diagram gives this approximately, and a useful deduction from it is that the number (total) of house lamps installed being very nearly 300 or 3-5ths of the lamp capacity of the dynamo, the load diagram shows (allowing about 4 A. for the street lamps) that only about one-third or less than one-half of these are in use at the same moment, which allows a considerable overloading of the dynamo. Probably plants will operate under similar conditions in other towns of the same size. Mr. Murray takes great care of his machinery; being an old engineer he appreciates the necessity of cleanliness and attention. His boiler, in which he burns coal and wood mixed, is thoroughly washed out with a hose every month or so, the tubes and smoke flue being cleaned every night after shutting down. An inspection of lines is made every week and every few days the transformers are examined and cleaned out. He is his own chief engineer, superintendent and clerk, and finds he can get along very well with one smart man to fire and generally look after things, and a small boy to do any little odd job around town—wiring lamps, &c. He is very particular in watching his pressure indicator, so that there is no trouble with lamps burning out. The lights are very satisfactory, and already the plant is earning a very fair dividend.



This plant has been selected for description as showing: 1. The necessity of thoughtful planning and designing of power house and capacity before purchasing. The conditions were carefully considered; a convenient unit put in; extensions provided for. 2. The advantage of using one type of machine instead of several. Off one alternating dynamo Aurora has house and street lights, a good load line, simple machinery, and not too much of it. 3. The satisfactory results of combining the two above advantages, and the evident possibility that a town of even 2,000 inhabitants presents a good solid investment to a cautious man. There are very many small towns in Ontario, some possessing even a good water power, who may achieve the same results with the same cautious planning.

It is intended in a future article to consider more especially the commercial features of a typical station, and to regard them in the light thrown on them by theory.

Incorporation has been granted by the Ontario government to the Magnetawan Tanning & Electric Co., to conduct a tanning business and supply electricity for light, heat and power. The promoters of the company are: Messrs. G. and W. T. Martlett, of Oakville; John Waldie and William Cameron, Toronto, and R. J. Watson, of Burk's Falls.

Messrs. Davey & Foley, of Thorold, Ont., are negotiating for possession of the water power at the village of Sturgeon Falls, where they propose to erect a $50,000 pulp mill, and supply electric light and power. They also ask for a bonus of $7,000, which the town is willing to give if the necessary power can be obtained from the Ontario government for that purpose.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of the various Associations are requested to forward to us matter for publication in this Department not later than the 20th of each month.

TORONTO ASSOCIATION NO. 1.

The members and friends of the above Association to the number of one hundered or more spent a very pleasant evening on November 21st at the Association rooms, Shaftesbury Hall, the occasion being a smoking concert which this year was substituted for the usual annual dinner of the Association. The chair was occupied by the President, Mr. E. J. Philip. An excellent musical and literary programme was provided, followed by an oyster supper. Messrs. Mackie and Langdon, of Hamilton , and Bassett of Kingston, were amongst the guests from a distance.

HAMILTON ASSOCIATION NO. 2.

At the last regulor meeting of the above Association, interesting papers were read as follows : "Boiler Compounds," by Bro. Mead; "The Coming Steam Engine," by Bro. Batty; "Railway Power Stations," by Bro. Nash. These papers evoked an interesting discussion. It is the intention of the officers of the Association to endeavor to provide papers at each regular meeting through the winter.

BROCKVILLE ASSOCIATION NO. 15.

On the occasion of the installation of officers of this recently organized association, an official visit was paid to the lodge by J. J. York, of Montreal, Executive President, and A. E. Edkins, Toronto, Provincial Deputy, who performed the installation ceremony. Following the installation an address of welcome was presented to Bro. Edkins. An adjournment was then made to the dining room of the St. Lawrence Hall, where a banquet was spread in honor of the visitors. Mr. W. F. Chapman, President of the new association, gracefully presided, having on his right Rev. W. A. McKenzie and Mr. York, and on his left Mr. Geo. A. Dana, M.P.P., and Mr. Edkins. Letters of regret were read from several prominent citizens who were unable to be present.

The toast list was as follows : "Canada Our Home," responded to by Mr. Dana, M.P.P.; "Brockville, the Island City," responded to by Mr. V. R. Marshall ; "Commerce and Manufacturs," responded to by Messrs. D. Derbyshire, John M. Gill and Mr. Garson, ex-M. P. P.; "Education, the Engineer's Aid," responded to by Messrs. Geo. R. Webster and T. J. Storey; "The C. A. S. E.," responded to by Bro. J. J York ; "The Ontario Association of Stationary Engineers," responded to by Bro. A. E. Edkins ; "Kindred Societies," responded to by Rev. W. A. McKenzie ; "The President and Officers of the Local Branch," responded to by Mr. W. F. Chapman.

The interest and pleasure of the occasion was heightened by the services of a male quartette, composed of Messrs. W. Bryant, Wright, Smith and Geo. Smart.

TORONTO, November 20th, 1894.

Editor ELECTRICAL NEWS.

SIR,—ON November 6th, I had the honor of organizing in Carleton Place, a branch of the C. A. S. E., which will henceforth be known as Carleton Place Association No. 16, C. A. S. E. I was ably assisted by Bro. F. Robert, President of Ottawa No. 7, Bro. F. W. Donaldson. and Bro. Cohen, of Ottawa. This branch starts out under very favorable circumstances, with about twenty charter members. After the organization and installation of officers had been effected, several of the members were called upon to express their views. Among them was the Mayor of the town, who is an old engineer. In his remarks he eulogized the C. A. S. E and its objects very highly.

President Robert of Ottawa No. 7, gave the members some good advice based on the work of the Association in Ottawa, and expressed his belief that No. 16 would prove a progressive and useful Association.

Bro. F. W. Donaldson also spoke in very high terms of the good work that the Association was doing, and urged the members of the new Association to attend the meetings and make them interesting.

The newly elected officers from the President down, expressed their intention of leaving no stone unturned to make the Association a success. The writer was also called upon for a few remarks, and to the best of his ability outlined the aims and objects of the C. A. S. E. The meeting then adjourned, after having spent a very pleasant evening.

On November 8th, Brockville Association No. 15, was instituted by our worthy Executive President, Bro. York, assisted by the writer. It was expected that Bro. Devlin of Kingston, Bro. Past President Wickens, of Toronto, and Ryan and Hunt, of Montreal would have been with us ; but unfortunately, Bro. Devlin was stricken down the night before with inflammation, and for some days was in a very serious condition, but is now on the way to recovery,—a fact which all our members will be glad to hear. Bros. Ryan, Hunt and Wickens, were unable to be on hand, which was a disappointment to all. During the afternoon, Bro. President York and myself were taken in hand by Mr. Storey, the genial Superintendent of the Canada Carriage Co., and shown through their extensive and well managed establment. Mr. Storey also very kindly drove us out to the new Asylum buildings, and other points of interest. In fact we were treated with the utmost kindness by everyone, and shall long remembered our visit to the Island City. The banquet in the evening was the most pleasant affair I have yet attended in connection with the C. A. S. E.

Yours very truly,
A. E. EDKINS, Prov. Dep'y.

MOONLIGHT SCHEDULE FOR DECEMBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	
1......	P. M. 7.30	A. M. 6.20	10.50
2......	" 8.20	" 6.20	10.00
3......	" 9.10	" 6.20	9.10
4......	" 9 50	" 6.20	8.30
5......	" 10.40	" 6.20	7.40
6......	" 11.00	" 6.20	7.20
7......	" 11.50	" 6.20	6.30
8	....	" 6.20	5.20
9......	A. M. 1.00	....	
10......	" 2.10	" 6.20	4.10
11......	" 3.30	" 6.20	2.50
12......	No light.	No light.	....
13......	No light.	No light.	....
14......	No light.	No light.	....
15......	P. M. 5.10	P. M. 8.40	3.30
16......	" 5.10	" 9.50	4.40
17......	" 5.10	" 11.20	6.10
18......	" 5.10	A. M. 12.20	7.10
19......	" 5.10	" 1.00	7.50
20	" 5.00	" 1.20	8.20
21......	" 5.00	" 2.20	9.20
22......	" 5.00	" 3.10	10.10
23......	" 5.00	" 4.20	11.20
24......	" 5.00	" 5.30	12.30
25	" 5.00	" 6.30	13.30
26......	" 5.00	" 6.30	13.30
27......	" 5.00	" 6.30	13.30
28......	" 5.00	" 6.30	13.30
29......	" 5.00	" 6.30	13.30
30......	" 5.00	" 6.30	13.30
31......	" 8.10	" 6.30	10.20
		Total,	244.40
		Grand Total,	2272.10

THE MARITIME PROVINCES.

Correspondence of the ELECTRICAL NEWS.)

ST. JOHN, N. B., November 21st, 1894.

Last week a well-known civil engineer was in the city making enquiries with reference to constructing an electric railway between this city and Fredericton. Persons who were spoken to about the matter expressed themselves in favor of it. They thought such a road could be constructed at a nominal cost, and that it could be made to pay a good dividend. The distance from St. John to Fredericton is 85 miles. The road would run through a rich farming section nearly all the way. There are several pretty little summer resorts along the river where city people spend the hot weather and where large numbers go for Sunday, returning to their work on Monday morning. The trains make only one trip between St. John and Fredericton daily. If the electric railroad is built the cars will make several trips daily between the city and these suburbs. They will make a trip to Fredericton and return same day. The gentleman who has interested himself in the scheme, told the writer that he would stop the cars wherever there was a person to get on or off. They would carry mail and light produce. There would be no depots. He thought the cars should be a little larger than those in use in the city. He thought they could travel twenty miles an hour without any difficulty. Another thing that would tend to make the road pay is the high rates of fare charged by the C. P. R. officials. It is calculated that persons patronizing the electric cars could make several round trips as cheaply as they can make a single trip via the C. P. R.

St. Stephens' new electric street railway is giving good satisfaction. The cars are twenty feet long on the inside, and can seat thirty persons quite comfortably. They are heated and lighted by electricity. The cars are richly upholstered in plush and are in keeping with the general excellent equipment of the entire road. They were built by the Jackson & Sharpe Company, of Wilmington, Del.

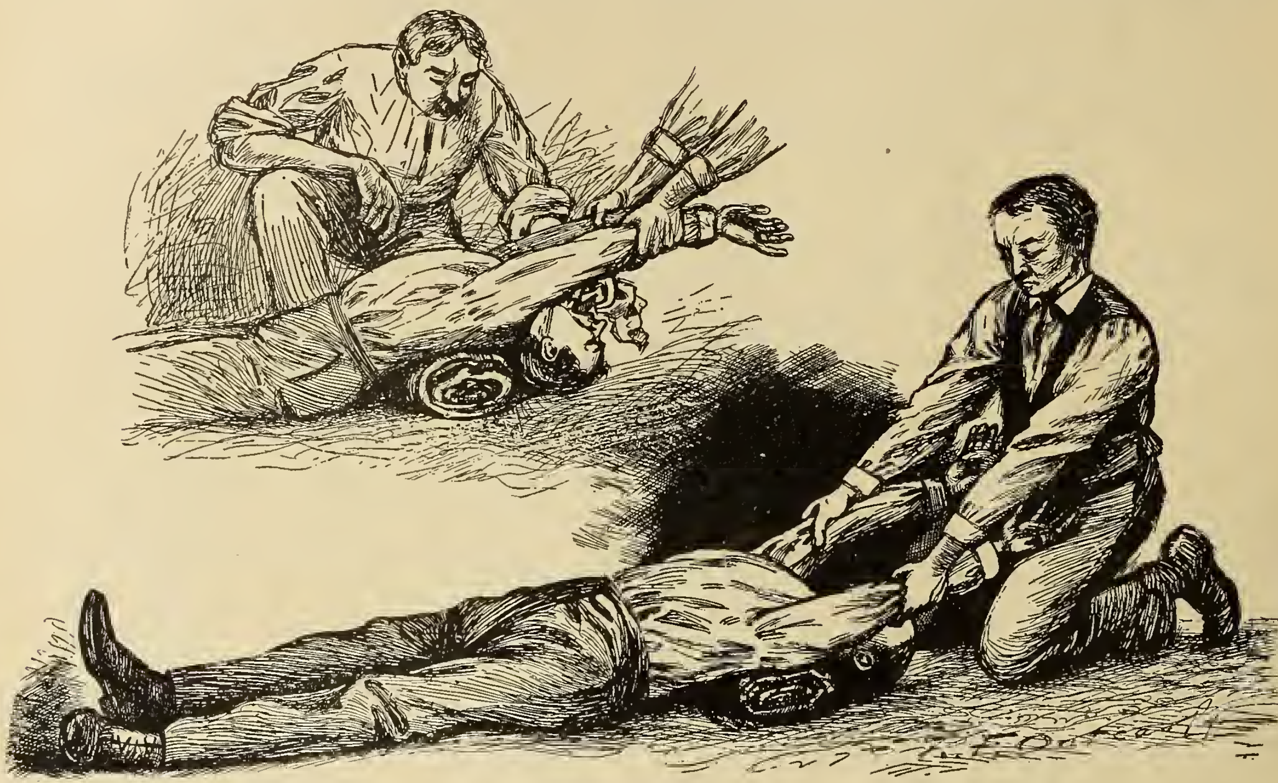
The snow storm that struck this city a few weeks ago caused more damage to the telegraph, electric light and telephone wires than any storm for over twenty years. Business was practically paralyzed for three days. The offices and stores on the main streets were lighted with oil lamps and candles for two nights. There was no telegraphic communication out of the city for some time. The telephone company suffered to the extent of several thousand dollars. They have not yet completed repairs.

A bonus and right of way has been granted to Capt. Carter, of Deseronto, for an electric railway to run from the G. T. R. station, Oshawa, to Oshawa-on-the-Lake.

HOW TO DEAL WITH APPARENT DEATH FROM ELECTRIC SHOCK.

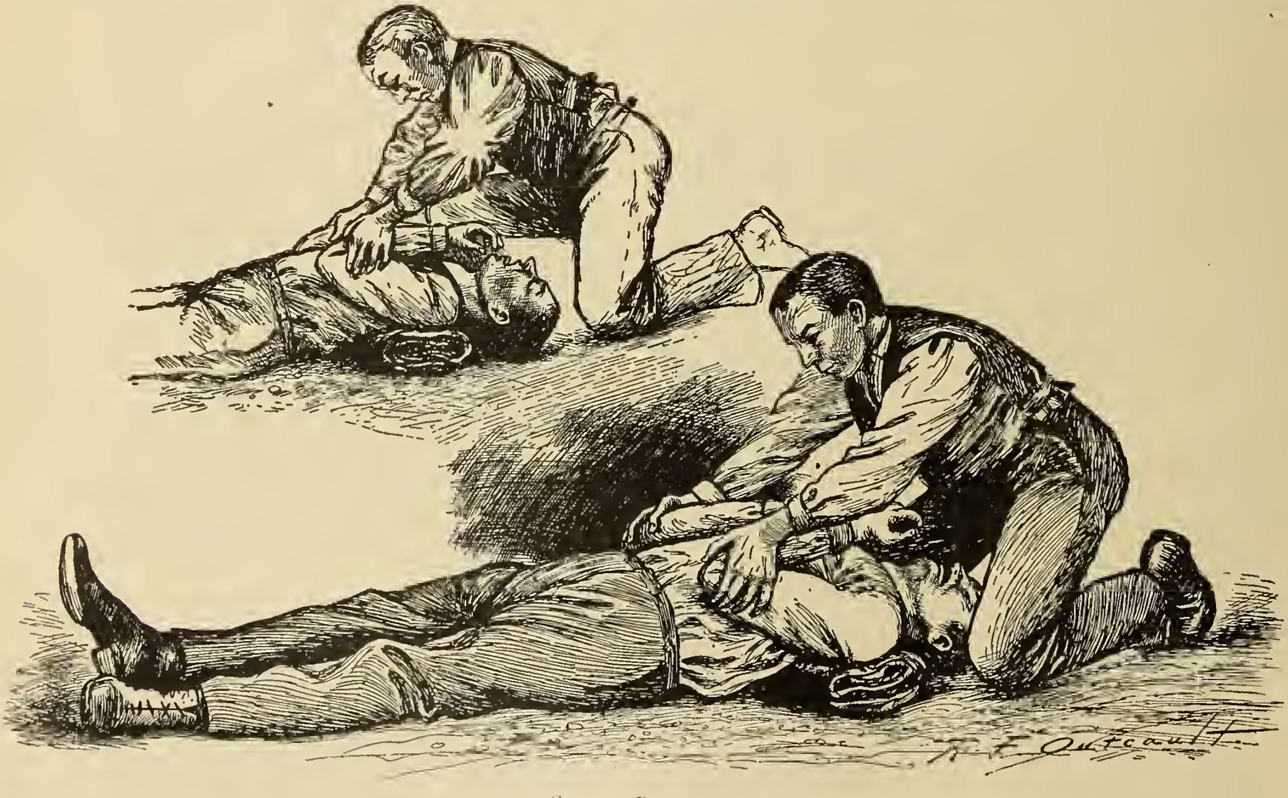
By Augustin H. Goelet, M. D.

Much interest has recently been excited by the report from France of the resuscitation of a man apparently killed by electricity, and by the announcement of the French scientist d'Arsonval that a person so shocked should be treated as one drowned. The suggestion is a good one but may be somewhat misleading unless understood; that is, unless the person undertaking the resuscitation appreciates what is to be accomplished and just how it is to be done.



First Position.

As this authority says, electric shock may produce death in one or two ways, viz:



Second Position.

(1) By producing destructive tissue changes, when death is absolute; or (2), by producing sudden arrest of the respiratory and heart muscles through excitement of the nerve centres, when death is only apparent; in other words animation is merely suspended. The subject may be aroused from this syncope if efforts at resuscitation are not too long delayed.

The alternating current, which is usually regarded as the most deadly, strange to say, nearly always produces death in this second manner

To say that a person has received a shock from a wire conveying a current of four or five thousand volts, does not necessarily signify that the body has been subjected to the full force of the current, even if the meter does register nearly one ampere during the time of the accident. In view of the fact that the human body offers a resistance of several thousand ohms, which resistance is greatly increased by imperfect contact, and by charring and burning the tissues at the points of application, it is not often that the internal structures or vital organs are submitted to a very considerable volume of current, though it apparently passes through the body. It must be borne in mind that when the clothing is moist with perspiration or wet with rain, it offers a circuit of less resistance than the human body, and in this event the body receives only a shunt current very much less in quantity than the main current. The bulk of current in this instance, passes over the surface and does not enter the body. This may explain the survival of some who have apparently withstood very powerful currents.

It must be presumed, therefore, that electricity seldom kills outright, though the condition of suspended animation, which it induces, would result in death if not counteracted.

All things considered, it is rational to attempt the resuscitation of those apparently killed by electricity, and if not too long delayed, the effort promises fair chances of success, provided proper means are instituted.

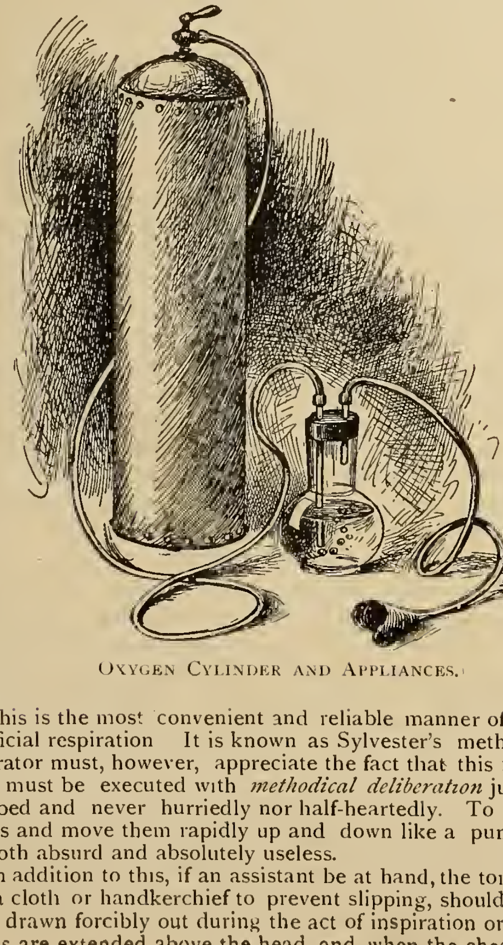
If the body has actually been submitted to a current of sufficient volume to produce destructive tissue changes, all efforts at resuscitation will, of course, be futile.

If, on the other hand, only respiration and the heart's action have been temporarily arrested, there is a condition of syncope simulating apparent death by drowning, or from anæsthetics, and the physician knows that patients in this condition are frequently revived. Laymen will appreciate the nature of this condition if it is explained as one of exaggerated faint and would not feel appalled upon encountering it if previously instructed how to cope with it. In an ordinary fainting spell the necessity to stimulate is universally appreciated. In syncope resulting from an electric shock stimulation is likewise indicated, but more vigorous measures are required. This is the only difference.

As said above, the direction to treat one shocked by electricity as one drowned may be misleading, as the conception of the layman of the necessities in this case would be to roll the body on a barrel. Let him understand that the condition is one of exaggerated faint, that the necessity is for prompt stimulation, and that the quickest and most powerful stimulent which can be employed is artificial respiration. *The man must be made to breathe*, if this is possible, and efforts to induce respiration must not be suspended until breathing is fully and normally restored or until it is absolutely certain that life is extinct. This cannot be assured in less than an hour's persistent, energetic, tireless effort.

The accompanying illustrations will serve to make intelligible the following directions for artificial respirations.

The body must be placed upon the back. A roll made of a coat or anything else convenient (*rolled*, not folded) is placed under the shoulders and must be sufficiently large to so prop the spine up as to drop the head backwards. The operator should kneel behind the subject's head, facing him, grasp the elbows and draw them well over the head, so as to bring them almost together above it, and hold them there for two or three seconds. Then he carries them down to the sides and front of the chest, firmly compressing it by throwing his weight upon them. After two or three seconds the arms are again carried above the head and the same manœuvre is repeated, at the rate of fifteen or sixteen times per minute. At the same time the tongue must be drawn out to free the throat. This manipulation stimulates respiration in the following manner, viz: When the arms are extended over the head, the chest walls are expanded, just as an inspiration, and if he throat is clear the air will rush into the lungs. When the arms are brought down to the sides of the chest, compressing it, the air is expelled, just as in expiration.



OXYGEN CYLINDER AND APPLIANCES.

This is the most convenient and reliable manner of inducing artificial respiration It is known as Sylvester's method. The operator must, however, appreciate the fact that this manipulation must be executed with *methodical deliberation* just as described and never hurriedly nor half-heartedly. To grasp the arms and move them rapidly up and down like a pump handle is both absurd and absolutely useless.

In addition to this, if an assistant be at hand, the tongue, held by a cloth or handkerchief to prevent slipping, should be seized and drawn forcibly out during the act of inspiration or when the arms are extended above the head, and when the chest is compressed it may be allowed to recede. This rhythmical traction upon the tongue is in itself an excellent stimulant of respiration. It acts not only by freeing the throat of the tongue, which may fall back and obstruct breathing, but also by reflex irritation, through the fraenum or bridle under the tongue being drawn forcibly against the lower teeth.

Should these efforts fail to elicit any response or arouse any signs of life, recourse may be had to another method of stimulation by exciting the dormant nerve centres. This should, however, be reserved for the physician, who should always be summoned when it is possible to get one, or should be made use of only by one who realizes the injury that may be done if it is carelessly practiced. Still, when the necessity is great and other means have been exhausted, some risk is allowable.

AN IMPROVISED MOUTHPIECE.

I refer to forcible stretching of the sphincter muscle controling the rectum or lower bowel. It is well known to physicians that this muscle is the last portion of the body to lose its sensibility and that by irritating it by forcibly stretching, a gasp will often be elicited from one actually moribund.

The method of procedure is this:

Turning the patient on the side, the index finger or thumb is inserted into the rectum and the muscle, which, if sensible, will be felt to resist, should be forcibly and suddenly drawn *backwards*, towards the spine. Care must be taken not to introduce the finger roughly, or to use sufficient force to lacerate or wound the parts.

Having obtained one gasp, artificial respiration should be continued and a repetition of the proceeding should be reserved until respiration again fails. In some instances, however, it may be necessary to repeat this with every effort at inducing inspiration, that is, every time the arms are extended over the head. The subject then being on the back, the knees are drawn upwards to facilitate access to the rectum.

If the accident occurs in a city or large town, oxygen, which may be obtained at every drug store may be used. This is a powerful stimulant to the heart if it can be made to enter the lungs.

This gas comes in cylinders furnished with a stop-cock and tubes and bottle, which latter is to be half filled with water through which the gas passes when turned on. [See figures.] If a cone or mouth-piece is not furnished with the apparatus, one can be hastily improvised from a piece of stiff paper and attached by a string to the ordinary mouth-piece. To use the oxygen, place the cone over the patient's face and turn on the stop-cock until the gas is seen to bubble freely through the water in the bottle. Efforts at artificial respiration should be kept up while the gas is being administered to favor its entrance into the lungs.

The use of electricity to re-awaken the heart and lungs to action offers another auxiliary to the resuscitation process, but implies the skilled employment of special electrical apparatus purely within the possession of the physician, who naturallly does not require instruction.

When I was requested by the editors of The Electrical World to contribute this article I gladly accepted because:

(1) I am convinced that many who have died in consequence of electrical shocks might have been saved if those at hand had been properly instructed in the methods of reviving suspended animation, and,

(2) I hope all electrical companies will be impressed with the importance of having their linemen and other employees engaged in the vicinity of dangerous currents, so instructed and trained that without delay methods of resuscitation can at once be instituted.

Thus the giant electricity will more surely become man's servant, a faithful and ever obedient one, instead of as now, occasionally, through man's carelessness, his slayer.—Electrical World.

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Correspondence is invited upon all topics coming legitimately within the scope of this journal

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THEY have their exits and their entrances. Exit the electric fan—enter the electric heater.

OF the 12,000 miles of street railway lines in the United States and Canada, about 7,200 miles are operated by electricity.

IT is understood that the Royal Electric Co., of Montreal, have made arrangements with the Stanley Electric Mfg. Co., of Pittsfield, Mass., to manufacture their apparatus in Canada under royalty. The Royal Electric Company have issued new bonds to upwards of half a million dollars. The money received from this source will, it is understood, be laid out in improvements to manufacturing plant and buildings. The company some years ago, started out to invent and manufacture apparatus on original lines. This policy is understood to have involved them in financial loss. The present arrangement, under which they will manufacture apparatus that has been well tested, will undoubtedly prove to be a less troublesome and in every way more satisfactory and profitable one, especially if accompanied by up-to-date methods in business management.

IN the case of the recent explosion of a boiler in a saw mill near Orangeville, Ont., which resulted in the death of two persons and in serious injury to others, the factory inspector for the district was obliged to consult the government before ordering an investigation, as under the Factory Act he was not authorized to hold an investigation unless there were at least six employees in the mill. In this particular case the employees numbered only five. As it is in the smaller mills and factories that the greater number of such accidents happen, owing to the employment of incompetent workmen and the neglect of proper safeguards, it would seem to be desirable that the Legislature at its approaching session should consider the advisability of amending the Factory Act in such a manner as to bring within its provisions the smaller mills and factories.

AT a meeting of the Executive Committee of the Canadian Electrical Association held a few days ago, twenty-five new members were elected. This must be regarded as a gratifying rate of progress. Each member of the Association has been asked to secure at least one new member during the present year. If this is done, the Association will become, what it ought to become, one of the largest and most influential organizations on the continent. Mr. Dunstan, the newly-elected President, is manifesting the deepest interest in the advancement of the Association. It is to be hoped that his enthusiasm will be copied by every officer and member.

PRICES in certain lines of manufactured products, have decreased fully fifty per cent. within the last ten years. If the manufacturers of these products had been told in the previous decade the price at which they would be obliged to sell in the present day, they would have seen nothing but ruin staring them in the face, and in many cases would no doubt have gone into other lines of business. But the result has not proved to be so disastrous as in that day must have seemed certain. Increased competition, followed by lowering of prices, has been accompanied by improvements in manufacturing processes, by means of which the cost of production has been largely reduced. The electric light has performed valuable service in this direction. By its use it is possible to operate a manufactory as perfectly by night as by day, and by running twenty hours instead of ten, the output of many factories has been doubled, and the larger production has enabled the owners to sell at a closer margin of profit.

THE Hamilton, Grimsby and Beamsville Electric Railway is the first of the Canadian electric suburban lines, so far as we are aware, to be operated by steam railroad methods. The company employ a train despatcher, and issue tickets from point to point on the line, which are collected and punched by the conductors. Under this system the passenger simply pays for the distance he wishes to travel, and not a fixed rate regardless of distance, as heretofore has been the rule on most lines of this character. The system is said to work most satisfactorily, and the road has already developed such an amount of business that the necessity for a double track and second power station at Grimsby is forcing itself on the attention of the directors. The fact that the methods of operation employed by steam railroads have been found to be necessary for electric suburban roads, is another proof of the contention made in our article last month regarding the duty on steel rails, that the suburban electric roads are not street railways, but railroads to all intents and purposes.

THE Dominion Government is called upon by some of the admirers of protection to encourage the manufacture in Canada of steel rails, by putting a stiff duty on rails imported from abroad. So far as rails for use in the construction of electric railroads are concerned, this has already been done. Steel rails imported for this purpose must pay a duty of 30 per cent., which in our opinion ought to be encouragement enough. If the government is determined to maintain the present duty on rails for electric railroad purposes, consistency demands that it should lose no time in imposing a like duty on rails for use on steam railroads. As was shown in our article on the subject last month, there is at present a distinction made where there does not exist a difference. If the imposing of 30 per cent. on steel rails for all purposes, would lead to the manufacture of rails in Canada, we presume the electric companies would be willing to bear their share of the burden for a limited time—say ten years—which should be sufficient to place the home manufacturers in position to compete with those abroad, as the Americans are now doing. If a steel rail industry cannot be established in Canada, under a protective duty of thirty per cent., it should be concluded that the conditions for cheap production are here lacking, or that our manufacturers do not possess the requisite knowledge of the economics of the business. Whatever policy the government may deem to be the proper one, should be announced at as early a date as possible, in order that the development of electric railways in Canada, which has so promisingly set in, may not be retarded; and above all, whatever the policy may be, let it be a consistent one.

ALL honest business men will read with pleasure Judge MacDougall's commendation on the upright course pursued by the Toronto Electric Light Co., under trying circumstances, when a most important contract was at stake. These bribe takers, influence sellers, and trust breaking commission receivers, are the pest of honest business. It is the special evil of all such dishonest and underhand methods of doing business that they doubly tend to make impossible any straightforward sale of goods on their merits alone. A sale effected by disreputable or dishonest means, is not only an increase of business to those dealers who will use such means, but it is at the same time a loss of business to some upright dealer. Every honest business man who wishes to prosper honestly is concerned in withstanding corrupt or underhand approaches, and owes thanks to all others who do the same.

JUDGE MacDougall's interim report on the investigation concerning the electric lighting contract, more than bears out the position taken by the CANADIAN ELECTRICAL NEWS. From the beginning of the municipal electric plant controversy we have uniformly contended that the crucial point in the question at issue is the unfitness of our municipal institutions to be intrusted with the control of any industrial department. With the possibility of jobbery in letting contracts for supplies, the probability of favoritism and political influence in making appointments, and the certainty of slackness in control of details, the futility of all estimates of running expenses under municipal ownership should be manifest. These evils are sufficient to condemn any such project, but added to these there must now be taken into account a form of corruption graver than mere jobbery, namely, direct bribery and the sale of votes for money. Judge MacDougall's report finds at least one Toronto alderman guilty of soliciting a bribe for his vote.

THAT prejudice dies hard even in this age of newspapers and modern improvements is seen in the objection taken by the farmers of Waterloo county against the building of an electric road in that locality, because the scheme would do away, in a great measure, with horses, and the latter would, consequently, depreciate in value. Everyone knows the trouble encountered when the spinning-jenny, the sewing machine, and the agricultural improvements of recent years were first introduced. All these had to run the gauntlet of prejudice and narrow minded criticism, and their history ought to prove to anyone who thinks or observes that the wheels of progress cannot be blocked in any such manner as this. When Stephenson was asked what was to become of the cow when steam became the propelling power with railroads, and the risk of slaughtering cattle in this manner increased, he simply answered that it was so much the worse for the cow. All men with a spark of humanity in their breasts love the horse, and from an economic standpoint know how much this noble animal has done to advance the best interests of city and country. He will still have his place in the commercial economy of the age, but let the farmers near Berlin and Preston make up their minds that it will be unsafe for him or them to run up against an electric motor. Agricultural communities have been immeasurably benefited by the opportunities the railroads have given them to carry the produce of their farms, not only conveniently to the adjoining market places, but to get this produce forwarded to the uttermost marts of the earth. The electric road is simply going to further their interests along these lines. Besides our good friend Rustic will be a more intelligent farmer, as he manages to get away occasionally from his hay forks and threshers and learns something of the big world around him.

IN the suit for damages brought against the Toronto Electric Light Co., the Holmes Protection Co. and the Bell Telephone Co., of Toronto, by a lady who suffered injury by coming in contact with an electric wire dangling in the street, a Mr. Cross, designated as "Electrician of the Cooper Institute, New York," was called to give expert testimony on behalf of the plaintiff. Mr. Cross is reported to have condemned in no uncertain terms, the character of the insulation employed in Toronto. For the purpose of testing the right of the witness to pose as an expert, a lineman of one of the defendant companies was despatched to procure a piece of wire from the scene of the accident. This piece of wire, with two pieces of new wire, was submitted to Mr. Cross for his opinion as to the character of the insulation. After having critically examined the three samples of wire, the witness is reported to have stated that they were all of good quality, and on being asked which of the three in his opinion was the best, he selected the sample taken from the scene of the accident. This demonstration of ignorance led to enquiries being made concerning this so-called expert. The result is, that he is declared to be unknown to the authorities of Cooper Institute, and so far as known, has held no position of importance which would entitle him to regard himself, or to be regarded by others, as an authority on electrical matters. It is due to the reputation of the local electrical companies, as well as to the public welfare, that we should protest against the statements which have been made by this self-styled "electrical expert," and which have been made the text for alarmist articles in the insurance and other papers. We would call attention to the fact that in the case in question, Judge McDougall had no fault to find with the character of the insulation.

A STATION load curve is drawn by plotting the load (in amperes, horse power or kilowatts) measured by vertical lines opposite the hours measured on a horizontal line. It is very easily done, and however small a central station may be, it's load curve should always be plotted from time to time. Although the manager knows in a general way, how the load varies at different hours during the daily running time, and at different seasons of the year, he can have no such clear knowledge of the variation as a plotted curve will give him ; and nothing can bring home to him so forcibly the possibilities of improvement. The area between the load curve and the horizontal line, whose length is the daily running time, is the actual daily output of his station. The area of the rectangle whose base is the same line and whose height is the full load capacity of his plant, is the possible daily output of the same plant. And when these are reduced to figures there will be few managers who will not be surprised at the small percentage the actual is of the possible output. "Load factor" is the convenient term which has been introduced to express this percentage, and a load factor of 40% is rare ; 20% is more like the average results. Take for instance a load factor of 25%, with a station which pays 6% dividends. This means, that with one quarter its greatest possible output, the investment is earning the whole of its interest in addition to the running expenses and depreciation, due to the actual output. Consequently, if additional load can be added to the same plant, any excess of income from it, over the entire running expense and depreciation due to it, is so much net profit. For special services limited to the slack hours, the station can profitably make special prices. With the load curve before his eyes, showing plainly and definitely the hollows to be filled up and the low levels to be raised, the manager can best apply his local knowledge of his customers and possible customers, to devising plans for meeting their needs without increasing his plant—plans increasing his customers or their profits, and showing to his own satisfaction on his annual balance sheet.

WHAT may almost be called the distinguishing characteristic of the electric railway as compared with its competitors, steam railroads on the one side and horse railroads on the other, is its ability to give with economy a service both rapid and frequent. With the same frequency as horse cars, the superior speed of electric cars induces greatly increased travel in towns, whilst on suburban lines running at somewhat less speed than competing steam roads, traffic flows to the electric and is built up by it, owing to the more frequent service given by the latter. Suburban electric service is most economical as well as most convenient when it is diffused over the day, whilst for economical steam service the traffic must be concentrated into the larger and consequently more infrequent units which have much less tendency to promote increased travel. But this characteristic has applications to other uses besides passenger traffic, though from the force of custom such uses are not readily discerned by the general public, and indeed do not always at once strike those whom they specially concern. An instance in point is the watering of the track allowance in summer by electric tank cars, as was done last summer in Toronto, better and at less cost than by watering carts. Another and much more important application is to local mail service. The carriage of mail matter from the post office to the railway station, as is done by the electric street railway in Ottawa, is only a small part of such service. In the United States the post office authorities have given the subject much attention, and Sir Adolphe Caron, postmaster-general, recently inspected the system in use at Brooklyn where the application of trolley cars to mail service has been carried further than in any other place. Besides carriage of mails to and from trains, from main post office to branches, and direct interchange between branches instead of through main post office ; carrier delivery is quickened by a car which, running on schedule time, takes out carriers' bags, sorted for distribution, and delivers them to the men on their beats, receiving from them letter box collections. For suburban service a car, with a compartment fitted up like a regular mail car, carries a mail clerk, who receives, sorts and delivers letters between post offices en route. Enough has been said to show the value of this use of electric cars, which will no doubt be extended as time goes on. As suburban roads are extended, improved mail service by them will be a great boon. At present a post office seven or eight miles from a large town may easily have poorer mail communication with it than Toronto has with Montreal.

THE reappearance of the Auer or Welsbach gas burner, and the vigorous way in which it is being pushed into use, render it a matter of interest to all concerned in electric lighting, and especially to those incandescent plants which have gas competition. The standard of perfect light is sunlight, and the ideal artificial light to be aimed at is the nearest possible approach to this standard of white light. The ordinary gas jet, oil lamps and incandescent electric lamps fail of this standard through the predominance of the yellow rays in their spectra. The arc light has the brilliancy which the incandescent light lacks, a brilliancy due to the extension of its spectrum well into the violet region, but unfortunately the violet rays are disproportionately powerful, with the result of giving not a white, but a bluish white light. The Auer light has something of the brilliancy lacking in incandescent lights, though not so much so as the arc light, but it has also a predominance of green rays, making it a greenish white light, with the usual rather ghastly effect which is inseparable from green light. Inquiries from users of the Auer light show that one of these burners, whose annual cost for gas is the same as the annual current cost of an incandescent lamp, gives much more light than an incandescent lamp ; but has offsetting disadvantages. It is a gas light with all the disadvantages of gas, and a few more added on its own account. It gives out heat, consumes oxygen, and produces carbonic gases and sulphurous fumes like any other gas jet. It requires the use of matches; each burner must be lit separately and the globes or glass chimneys must be kept clean. The cones or mantles are frail ; their life is reported to be about 700 hours. They are renewed annually free of cost, but if broken or burnt out in less time they cost for renewal twice the present price of incandescent lamps. It cannot be said that the color of the light is popular, and some reports state that long before the mantles are burnt out, the bright greenish white light of the new mantles becomes very much less bright and very much more green. This last defect, if true, may perhaps be got rid of by improved manufacture, and policy may dictate free renewals. But giving the Auer light the benefit of every doubt, what remains ? A cheaper but rather more troublesome gas light, of a not pleasant color, and too glaring for agreeable use in offices or dwellings. It is not easy to see that there is anything in this to send electric light stocks tumbling. Incandescent lamps, clearer than gas jets and no brighter, forced themselves into use in the face of established gas lights. The fair inference is that their use is largely based on other qualities than brightness and cheapness, and these qualities are not infringed by the new gas burner. If the Auer light is deserving, and has its sphere, it will find it ; but it does not seem likely that this sphere will much if at all overlap the legitimate sphere of the incandescent light. If they do seem to come into competition, it will probably be in that no-man's-land which lies between the ordinary incandescent and the ordinary arc light, and a very promising electric claimant for this poorly occupied territory is coming to the front in the form of the small arc or subdivided arc. In the meantime the present Auer light is something new to the public ; doubtless many people will try it, doubless also many of them will discard it ; and during this trial stage it behooves the electric light companies to see that they do not lay their light open to just criticism by poor regulation, low pressure, or worn out and blackened lamps. The Auer light is not a recent thing ; it has been more or less in the field for some years ; the present form is presumably an improvement, and its present use is greater than ever before, but some months must elapse before anyone can judge whether it is here to stay or whether this is merely a boom. In the meantime let the electric light companies "keep their powder dry," by carefully maintaining the quality of the light they furnish.

THE ONLOOKER.

"A fortune is in store for the man," said W. E. Davis, electrical engineer of the Toronto Street Railway Co., "who will invent a trolley wheel that will give satisfaction to street railway companies." At the time Mr. Davis made this remark the conversation was interrupted by the entrance of a workman from the shops, who was endeavoring to overcome some of the difficulties resulting in loss of power sustained by the present trolley wheels. The remark was made that there was, perhaps, not another electric road in the country that lost as much power in this manner as the Toronto Company. The Onlooker asked for an explanation, and Mr. Davis was disposed to credit a good deal of the trouble to the style of rails that were in use in Toronto. He said : "You notice the frequent flashing out of light that one will see at night as a car proceeds along the road. This is due to the kind of rails in use, causing unevenness and jumping, and especially is this the case using trailers to the extent that we do on the system here. However, this is the only rail that has met the requirements of the city engineer and the company will have to do the best it can under the circumstances." The Onlooker asked Mr. Davis if it was the intention to heat the cars this year with electricity, and he answered with an emphatic "No." The cost, as compared with the use of stoves was altogether too heavy. It would require about 400 horse power, said Mr. Davis, to satisfactorily heat the cars by electricity and there would be no money in that. Noticing in the works near by the remains of an old guard for preventing accidents, the Onlooker enquired if the company had got at anything satisfactory in that direction. "There is just this about it," replied Mr. Davis, "we are now using a guard that meets with the approval of the city engineer, though probably a score of different guards have been submitted to us for trial. The one in use is the same as is being used in Buffalo." It is most necessary that every precaution should be taken against loss of life through the rapid transit system in use to-day in nearly all large cities. But the more complete solution would seem to be outside of anything as imperfect as a guard in front of the motor. Perhaps the electric brake, fully described in the paper by Mr. Elmer A. Sperry, of Cleveland, and read before the recent meeting of the Canadian Electrical Association is destined more completely to meet this necessity than any other scheme. Mr. Sperry has succeeded in bringing the electric brake to a high degree of practicability, and it does not need much observation or thought to recognize that where accidents occur on electric roads these are due to the fact, usually, that the speed of the car has not been more quickly arrested. Mr. Sperry's patent combines the two methods of braking by converting the car motor into a dynamo, and by utilizing the current as an intermediary for the generation of magnetism to operate the magnet, and applying them together simultaneously.

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In the field of practical electricity, one hears less, perhaps, of development in telephonic affairs than in some other branches of the science. Touching on this matter in conversation with Mr. K. J. Dunstan, manager at Toronto for the Bell Telephone Co., and the genial president of the Canadian Electrical Association, this gentleman remarked to the Onlooker : "It would be a mistake to judge from this fact that no progress was being made in this department of electrical science. We go on our way quietly, giving apparently satisfactory service to the public, but I question if in any other field greater advances are being made than in handling the telephone business. Constant improvement in all the details of the business is the order of the day, and it can be understood that in a work like ours where the smallest details are of great importance, where, in fact, in the matter of time, we count by seconds and the fraction of a second is an item of importance, marked development may take place and yet only those who are closely watching the work will realize the fact. I might, for the moment, refer to the new switch board that is being placed in the Exchange at Toronto, and to which the ELECTRICAL NEWS has already made some reference. Just take the case of the automatic drop that will be a feature of the new switch board. It will prove a saving of time and labor in the handling of the business of this Exchange that will materially help operations at this end of the 'phone, as well as each individual subscriber." The Onlooker, however, will not draw further by way of illustration on the new switchboard, as when it is fully completed, which will be shortly, a description in detail, which will, no doubt, be interesting to readers, will be given in these columns. Whilst the principle of the telephone dates back many years. as readers of this journal will know, it remained to Alexander Graham Bell, of Boston, in 1877 to discover the method by which all the characteristics of sound, pitch, intensity and quality could be transmitted. This is less than a score of years ago, and when one recognizes this fact and thinks of the perfected character of the telephone business of to-day, then is realized the force of Mr. Dunstan's remark as to the progress made in this department of electricity.

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The matter did not come up directly in conversation with Mr. Dunstan, but enough was said to suggest to the Onlooker that with the improvements being made in the telephone there will also come a remedy for some of the abuses that are common to the service. This may be said to be a commercial, rather than a scientific phase of the business, but the abuse of the telephone service grows to such an extent in all towns and cities that companies are seeing the necessity of applying remedies more vigorous than have yet been adopted in many places. One evil is overcome in some cities by making a charge for the telephone to cover simply so many calls; beyond that figure within the period of lease an extra charge is made. It may be expected that this plan will in time be more universally adopted. The new device for registering the calls made on telephones has reached that degree of efficiency that no trouble need be realized in keeping a record of these between the exchange and the subscriber. How convenient it is to drop into a neighbor's and use the telephone ! Everyone, of course, realizes this, but from the standpoint of the telephone companies, while this may be "nuts" to the invidual it is not business to the company. A remedy in this direction would doubtless lead to a considerable extension of the service, and the convenience that would follow would be realized by many to-day, who clandestinely employ the service ; and to the extent that everyone appreciates an article better when it actually becomes his own, so it would be in the case of the telephone.

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To the splendid equipment of the Toronto Street Railway Co. has recently been added a new 1,600 horse power engine from the factory of Laurie Bros., Montreal. The engine is one of the largest in use in Canada to-day and the largest used by any electric railroad. The Onlooker had an opportunity lately of inspecting this engine, which had then been in operation three weeks, and had particulars of its operation fully and intelligently described by Mr. Ross, mechanical superintendent of the Laurie Bros., who was giving the engine the usual manufacturer's test. He said, that from the moment the engine had been started perfect satisfaction had been given, and this remark was confirmed by Mr. Davis, electrical engineer, who kindly showed the Onlooker through the power house. This engine is the only one in Canada not belted. It possesses a steam jacketed cylinder, and is the only engine in use in the Dominion with a water jacket. The large wheel is a sight to look at, being 20 feet in diameter, and the rim of it 18 inches square. Some conception of the size of the engine may be obtained when we state that the rim weighs 40 tons, a 22 inch shaft 17 tons, the discs 6 tons each, and the generator 23 tons. The construction of the engine is such that it may be worked in two separate parts, or together. If an accident happens to one part it can be closed off and the other part worked singly. The Onlooker, whilst inspecting the engine with Mr. Ross, had the pleasure of meeting Mr. Rutherford, chief engineer for the Toronto General Electric Co., who furnished the generators. This machine is classified as M.P. 10-800-90, having 10 poles, being 800 k.w. capacity, and running at 90 revolutions per minute. It is the same size machine as the one which was operated so successfully at the Intramural Railway and of which there have been over 50 sold in the United States and Canada, within the last year. The frame consists of two steel castings weighing, together with their pole pieces and spools, nearly 40 tons ; the armature is of the iron-clad type and weighs nearly 25 tons, making a total weight of 65 tons. The machine is rated for a regular running load of 1,500 amperes, but as much as 2,400 amperes have already been taken from it for short intervals. This current at 550 volts is equal to close upon 2,000 indicated horse power at the engine. The machine is connected to the bus bars through one of the Canadian General Electric Company's latest type "K" circuit breakers which when opened at 2,500 amperes when the machine was under test, not only showed itself to be everything that could be desired, but proved that the dynamo could stand a strain of this description without bad results of any kind. Indeed the neutral points for no load and full load are so close that it was not even found necessary to move the brushes. It may be interesting to know that this machine was delivered at the power house within one month after receipt of order.

The Hutton Electric Co., of Huttonville, have installed a new 750 light incandescent dynamo. Another copper conductor will be erected to carry the current from this new machine to Brampton.

The council of the town of Farnham, Que., have declined to renew their contract with the electric light company at that place, and are considering the question of owning and operating their own lighting plant.

LIGHTNING ARRESTERS.*

By James Burnett.

Lightning Arresters, or perhaps more properly, "Lightning Diverters," are included in the list of appliances that are requisite for the proper maintenance of a modern lighting or power plant that has connected with it any considerable stretch of outside or overhead lines. The subject of Lightning Arresters is of considerable importance when the number of burn-outs and shut-downs, in consequence of lightning, is taken into consideration, and a large variety of ingenious types of lightning arresters are now furnished for arc lighting—low tension, continuous current, alternating current and street railway circuits.

Probably the first and pioneer device under the above heading is the lightning rod, over which so much learned discussion was spent even an hundred years ago. We are told that there were two factions—the ball and the point—one advocating that every rod should terminate in a ball, and their opponents clamorously championing the merits of a rod finishing off in a point or series of points. Even this question has not received its quietus yet. A few notes on this subject will be given later.

Generally speaking, for electric lighting purposes, an efficient lightning arrester should be possessed of the ensuing features:

1. To provide discharge circuits which shall operate automatically and repeatedly, and which shall with certainty forestall and prevent a short-circuit of the dynamo, in case both lines are struck by lightning simultaneously.
2. To provide lateral discharge circuits, so arranged that they shall invariably offer a certain path for the lightning to ground, in preference to the other part of the system, which includes the dynamo, motor, etc., to be protected.
3. To be constructed so that free access may readily be had to its essential parts—an important consideration at all times, and often overlooked in the design of some lightning arresters.

The lightning which it is proposed to guard against has certain peculiar though pretty well-known qualities. Its chief characteristic consists in the fact that in the event of its coming in contact with a path of comparatively low resistance for normal currents, it may find in this path a high impedance to itself. This is especially the case when convolutions or sharp bends are inserted.

Lightning has in consequence a tendency to discharge laterally on coming in contact with a path of this description.

This phenomenon of impedance is termed self-induction or electro magnetic inertia.

Fig. 1 exemplifies an experiment that bears out this statement. A current of high voltage and of a highly oscillatory character (which possesses analagous properties to lightning) is passed from A to C, and instead of going over the path A, B, C, it jumps the gap at G in preference.

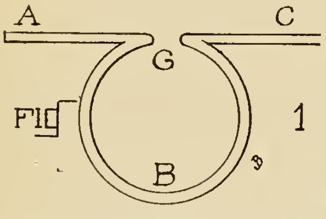
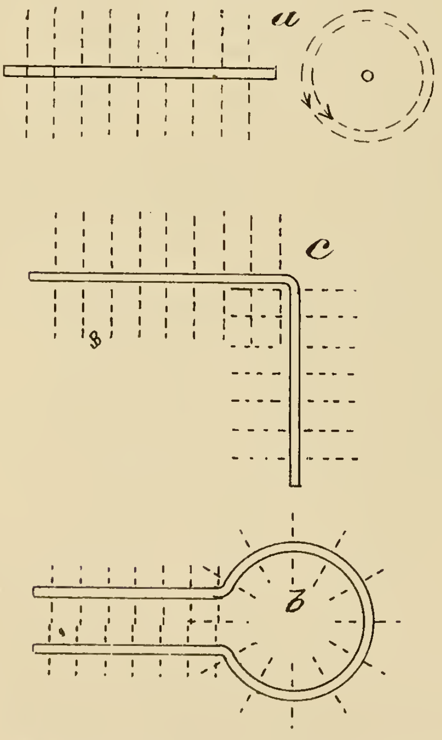


FIG 1

Several theories of this peculiar and characteristic effect of self-induction are given—one of them being, that when current passes through a conductor it opens out magnetic lines of force at right angles around the conductor, (*a* Fig. 2.) When the conductor is straight, these lines of force do not interfere with one another, but when any convolutions B or sharp corners *c* are inserted, then the magnetic lines or whirls cause an impedance or obstruction on the passage of a current analogous to lightning. Coils that give this effect are termed "choke" or "reactive" coils, and only manifest this peculiarity with alternating currents. It has been demonstrated that a flat spiral will offer a maximum impedance with a given length of wire. The impedance does not continuously increase with the number of turns, but reaches a maximum at about the seventeenth turn. The impedance is not perceptibly increased by the introduction of an iron core to the coil, if the core be thoroughly laminated.

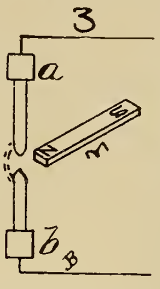
FIG 2



We may now proceed to enumerate a few of the best known types of lightning arresters.

The magnetic type is the one most in use, and combines many good features, with simplicity of parts and principle. It has no moving pieces, and all parts are readily inspected. This type is based on the well-known principle that an arc, except of static origin, cannot exist when its path interposes a strongly excited magnetic field. An interesting experiment neatly illustrates this. An arc is struck between electrodes *a* and *b*, Fig. 3, and the magnet M is brought near. The arc is in consequence deflected, as shown on the dotted line, by the repelling force of the magnet, and in consequence its length and resistance are increased. An increase in the repelling force (such as nearer proximity or increase in excitation of the magnet) tends to rupture the arc.

FIG 3



The Thomson Lightning Arrester, (Fig. 4,) for arc and low tension continuous current circuits, has a magnet *m*, and two metal wings *a* and *b*, about ⅛″ distant at *g*; *c* is a small contact piece placed ⅛″ from *b*, and is connected to ground; *a* is connected to the line. The other side of the circuit is similarly connected. In the event of the line wire being struck by lightning, the inductively wound coil, *m*, offers an impedance, and the gaps at *a-b*, and *b-c*, are jumped, thus affording a good path to ground. A heavy current from the dynamo usually follows, and the magnet is highly excited, taking current from the dynamo, as it is in shunt to the arc at *b-c*. The arc is immediately repelled to the furthermost extremity of the wings, and is broken by either its own resistance or its own heat, causing a draught of air, which blows it out.

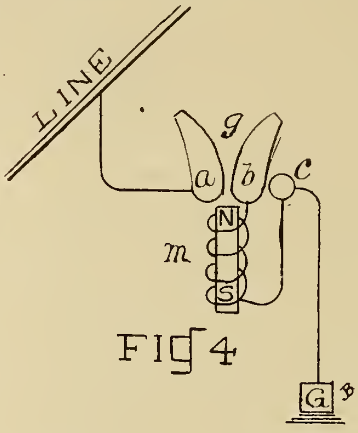
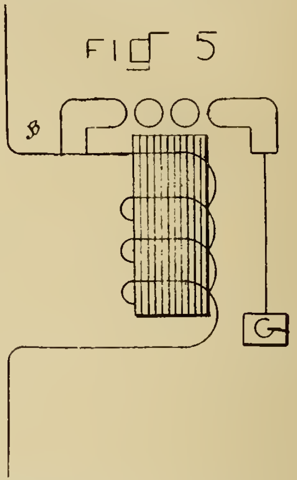


FIG 4

FIG 5



The Thomson Arrester appears also in another form for alternating currents. In this type the magnets are laminated and are excited at all times by the line current being in series with the line. This is a desirable feature, as the magnet does not take any precious time to build up its strength, as in the continuous current types. Anyone who has observed what a short time it takes for an alternator—especially smooth core—to burn out on a short circuit, can appreciate this feature. This lightning arrester often may work without appreciable flickering of lights.

FIG 6

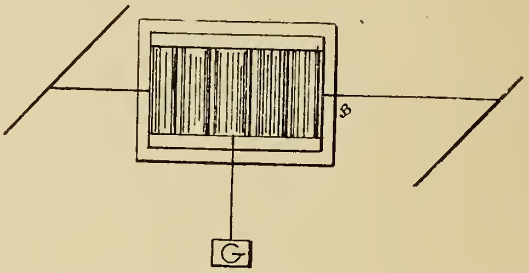


Fig. 5 shows the connections of this arrester.

The recent discovery of what is known as "non arcing metal" has brought out arresters of novel type, principally by the Westinghouse Electric and Manufacturing Company. A very neat and novel arrester is the alternating non-arcing, which I think is destined to adorn many a switchboard in Canada before long.

The arrester for high tension alternating circuits consists of a number of rollers—usually seven—about an inch in diameter and separated slightly, the gap being about 1-16 inch wide. (Fig. 6). These rollers are composed of what is termed non-arcing metal. This metal is understood to consist of an alloy—copper, antimony and lead, in suitable quantities. The arrester is neatly mounted on a marble base. The gaps readily permit of the passage of a spark of static origin, but the normal current is effectually debarred from passing. This alloy is only "non-arcing" for alternating currents, straight currents not being checked in this manner.

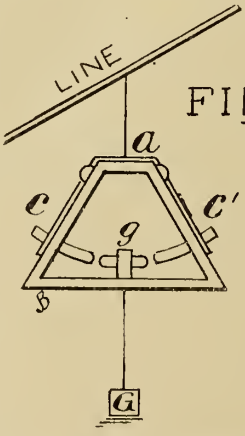


FIG 8

The Keystone type (Fig. 8,) is also well known, and as its name implies, takes the shape of a keystone of an arch. This arrester is adapted for continuous currents. The line is permanently connected to *a*, which terminates in two carbons, *c* and *c*′; carbon *g* goes to ground. Lightning passes the gap at *c-a*, and the heavy normal current from the dynamo rapidly heats the air enclosed by the marble box m, and in expanding, the air forcibly blows out the carbons c and c^1 (hinged at h) and the arc is immediately ruptured. The carbons return at once to their original positions, ready for the next discharge.

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*Paper read before the Montreal Electric Club.

The Wurtz arrester (Westinghouse) for continuous currents, is based on the principle that if an arc be struck between two metal pieces, and the whole enclosed in an air-tight box, the arc dies a natural death, not enough metallic vapors being generated to furnish a path of good enough conductivity. This arrester consists of the two brass blocks a and a^1 (Fig. 9), both held by a wooden block of walnut W. A walnut cover fits over the metal pieces, acting as a cover. A lignum vitae strip L is interposed between a and a^1. The surface of this strip is charred in serrated grooves, nine in number, to offer a high resistance path from a to a^1, which is connected to ground; a is permanently connected to the line wire. The box is about 6x8 inches and about 4 inches deep. It is made of iron, with rubber gaskets under the cover, and neat stuffing boxes for the lead wires. This prevents the entrance of much air to "feed" the arc. This type is recommended for use on continuous current circuits up to 1000 volts. This arrester has many neat features, but being enclosed in a box, is not readily accessible for inspection.

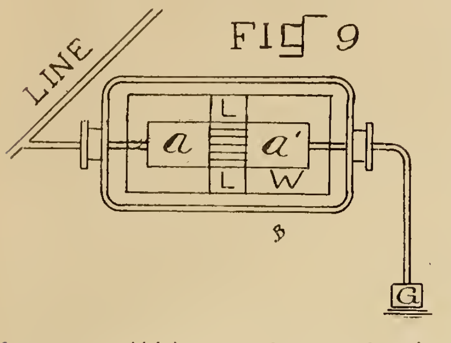

FIG 9

A simple type is the Tank lightning arrester, shown in Fig. 10. This is merely a high resistance path to ground, with circuit opener or fuses inserted. It is well adapted to railway ground return circuits, and is usually only connected in on the approach of threatening weather. The tank t is filled with acidulated water and the brass supports hold up a series of carbons c. One set is connected to line and the other to ground. An arrester of this type may be seen at the Montreal Street Railway power house on William Street. It is connected to the line wires by a flat ribbon of copper to obviate self-induction.

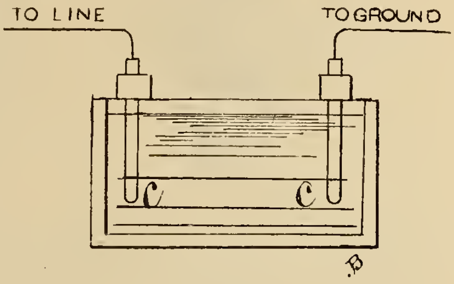

FIG 10

Fig. 11 shows a method of connecting any ordinary type of arrester. The inductively wound choke coil is inserted between the dynamos and the line. This increases the resistance of the line to the dynamo, and is easily constructed. The value of any well known type of arrester is strengthened by this simple device. Many notes of interest may be found in Mr. Wurtz' paper on "Arresters" in recent numbers of the electrical journals of the United States.

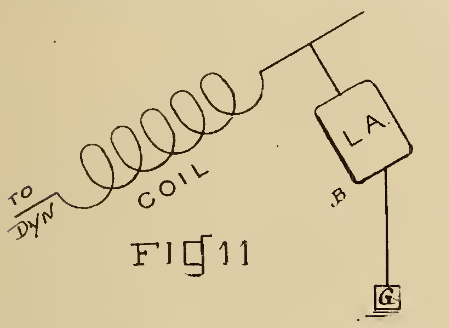

FIG 11

Lightning rods, as before stated, are not an absolute protection, however well made. Dr. Oliver Lodge has said: "An idea at one time got abroad that my experiments proved existing lightning conductors to be useless or dangerous, this being an entire misrepresentation. Almost any conductor is better than none at all, but no known conductors are reliable. However, they are essential to anything like security."

Some curious and interesting facts about lightning have been compiled by Mr. Alex. McAddie, of the U. S. Weather Bureau. Statistics compiled by him show that in 1892 in the United States 251 lives were destroyed and 839 fires were caused by lightning, the latter causing damage to the amount of three million dollars. One interesting point which appears to be shown by statistical studies of lightning stroke is the decreased liability to accident in thickly settled communities. The risk in the country may be taken as five times that in a city.

The function of a lightning rod is two-fold: first, that of conducting the charge to earth; and second, the prevention of a disruptive discharge by silent neutralization of the cloud electrification. This latter explains why a rod should terminate in a point and why points well grounded are desirable on buildings. The efficiency of a rod is reduced by blunted points and discontinuity of connections. The Lightning Rod Conference in England reported in 1882 that "to carry the lightning flash the lightning conductors should offer a line of discharge more nearly perfect and more accessible than any other offered by the materials or contents of the edifice to be protected." Roughly speaking, a rod will protect a conical space around it, the radius of whose base is equal to the vertical height of the rod above the ground, but whose sides are curved inwards instead of being straight.

In conclusion, a few salient points regarding lightning rod construction may be given:—

1. Make rod of iron or copper in tape form if possible, terminating in a short rod which is plated or composed of some metal which does not oxydize. The rod should be as straight as can be erected.

2. Insulation from building is not necessary; in fact, connection with tin roofs or large masses of metal is desirable.

3. Grounds should be carefully made. Earth plates should be of large capacity and covered by water or damp earth. Water or gas mains are desirable as grounds, but mains of small diameter, such as an inch or under, should be discarded on account of their liability to fuse.

4. Large buildings should have a series of points connected to separate grounds, and also connected to one another.

SPARKS.

The Midland Electric Light and Power Co., Midland, Ont., is applying for incorporation.

Kincardine has decided to place the management of its electric light system in the hands of commissioners.

The town council of Buckingham, Que., has granted right of way to the Buckingham Electric Light and Railway Co.

It is understood that large extensions are to be made to the capacity of the Northwestern Electric Co.'s works at Winnipeg.

Additional plant is being installed by the Portage la Prairie Electric Light Co., by means of which the lighting capacity will be brought up to 1200 lights.

The London Street Railway Co. have appealed to the Supreme Court to set aside the judgment of the Court of Appeals, preventing the company from double tracking their lines on Dundas Street.

The New Westminster & Burrard Inlet Telephone Co., of Vancouver, has arranged with the Canadian Pacific Telegraph Co. for the use of its lines for telephone purposes between Westminster and Washington Territory points.

It is said to be the intention of the Ottawa Railway Co. to extend their line to Aylmer, Que., via Hintonburg, Skead's Mills and Britannia, crossing the Ottawa river at Deschene Rapids by means of a bridge to be constructed at a cost of $150,000.

It is reported that the stock of the Montreal Street Railway Co. is largely going into the hands of private investors. Mr. Jas. Ross is the largest individual shareholder, his interest in the company amounting to upward of half a million dollars.

The town council of Aylmer, Que., has granted a twenty years' franchise to the Hull Electric Railway Co. The proposed road between Hull and Aylmer, a distance of eight miles, will be lighted, it is said, by arc lights, placed a quarter of a mile apart.

Philadelphia street cars are said to be fitted with electric buttons, which are used by passengers to stop the car. This is certainly an improvement on the system generally in use, by which passengers are obliged to rise to their feet and pull the bell rope.

Mr. E. Franklin Clements, of Yarmouth, N. S., is one of the leading promoters of the proposed railway between St. John, N. B., and Yarmouth, N. S. It is said to be the intention of the promoters of this road to attempt to use tidal water power, and by this means to greatly reduce the expense of operating the road.

The Galt and Preston Street Railway Co. expect shortly to receive authority to increase their capital stock and extend their line to Hespeler. The intention is to clear the ground during the coming winter and commence track laying early in the spring, with the object of having the extension in operation by the first of June next.

The Ottawa Street Railway Co. is issuing new stock to the amount of $187,700. This will bring the total capital stock of the company up to $813,300. The new stock is offered to shareholders at par. The company thus far have paid eight per cent. on their capital stock, and the stock is quoted at 150. The object of the new issue is to pay off the floating indebtedness, and to provide for extending the road.

Mr. A. J. Corriveau, promoter of the Montreal Park & Island Railway and other electric railway enterprises on the Island of Montreal, brings suit against Mr. W. S. Williams, his late partner, to recover $250,000 of paid-up stock in the Montreal Park & Island Railway Co., which he claims was secured under false pretences. Mr. Corriveau states that Mr. Williams undertook to bring into the company a large amount of American capital, which he failed to do.

Mr. W. E. Rathbun, of Deseronto, the principal stockholder in the proposed Oshawa electric railway, has deposited with the municipality bonds to the amount of $2,000 as a guarantee that the first section of the road will be completed by the 15th of June next, the second section by the 15th of July, and the third section by the 30th of September. Mr. Rathbun stated to the council that $15,000 had already been expended on the enterprise, and that not less than $100,000 would be expended before the road was completed.

A company has been organized at Summerside, P. E. I., with a capital of $10,000 to supply electric light and power. The provisional didirectors are: T. B. Grady, Pres.; Leonard Morris, Secretary; R. T. Holman, Neil McQuarrie, Neil McKelvie, Neil McLeod and H. W. B. Stavert. The necessary plant has been purchased from the General Electric Co., through Mr. Freeman, their agent at Halifax. The company expect to start operations before the first of the year. The town council have make a proposition to the company to light the town with thirty-three incandescent 32 candle power lights for a term of three years, at the price of $600 per year.

The annual report of the electric light department of the City of New Westminster, B. C., shows that the city lighting plant, which is owned and operated by the municipality, consists of 1 Corliss engine, 180 h.p.; 1 Doty high-speed engine, 150 h.p.; 1 Ideal high-speed engine, 150 h.p.; two arc dynamos of 2000 candle power each; two 1500 x 16 candle power nominal, with extra armature; and one 650 x 16 candle power incandescent dynamo, with two extra armatures and other appliances complete. There are now 87 arc lamps on the streets, and 3,125 incandescent lights installed in public and private buildings. There are about 45 miles of wires on the streets. The lighting committee make the following complimentary reference in the report to the work of the manager of this department, Mr. P. T. Bowler:—"Too much cannot be said in praise of our Manager. It would be impossible for him, if the concern were his own, to take a greater interest in the working of the institution, and he is frequently found at his duties until all hours of the night, in order that the best possible satisfaction may be given to customers, although he is the poorest paid electrician (where similar responsibility is undertaken) upon the Coast, whilst second to none in point of competency. So economically has the department been managed that it is almost impossible to convince the public that everything is being charged to it that should be." It is proposed to add to the plant an additional boiler, should the present demand for lighting continue.

QUESTIONS AND ANSWERS.

"Doubtful" writes: Kindly inform me through your valuable paper whether or not (1) there are any incandescent lamps in practical use that are made with platinum filament? (2) If so, where are they made, and (3) about what proportion of cost to correspond with the ordinary lamps? (4) If they are made, is there any advantage in using them?

ANS.—No. Platinum filaments were frequently used in early experiments, but a high resistance lamp is essential to the distribution of light by incandescent lamps; otherwise the size of the copper conductors would have to be greatly increased. The solution of the problem was the invention of a carbon filament.

J. L. M., Orillia, Ont., writes: I would like to know if it is possible to make a permanent magnet about 8 inches long by about 1½ inches square to hold about 8 lbs. on one side. If it can be made, where could I get such made, and about what should it cost? I wrote to one manufacturing firm; they replied that they would not undertake to make it, but would give no reason.

ANS.—A bar magnet of the size given would not hold up as much as eight pounds. Any blacksmith can cut off a piece of steel of the required size, and it can be magnetized at any place where there is a dynamo. The best quality of tool steel should be used, and it should be hardened and tempered to a dark straw color at the ends. The cost of such a piece of steel, hardened, should not be more than 50 to 75 cents.

L. O'C. writes: We have been having some trouble with the armature on one of our Ball machines, owing to the wires which connect the armature to the commutator web breaking. Can you assign any cause for this? The machine was shaking a good deal when the trouble first occurred, but we have corrected this to a great extent, and still the trouble goes on. The wires are not rubbing on the field magnets, or any other part of the machine. I have soldered them as they break, but in two or three instances the new wire I have put in has broken—not where it was soldered, but the wire itself. The machine is a 35 light, 4 amp., Ball arc. If you know of anything that will remedy this, kindly let me know.

ANS.—This is a common trouble in Gramme ring armatures, with long lead wires to commutators, when there is any possibility of sustained vibration of lead wires. For this reason the lead wires are commonly stayed together by a weaving of cord or rope in and out between them, extending from the commutator to the armature. We shall be pleased if any of our readers who have had a similar experience will state what means were found successful to remedy the trouble.

"HOUSE ORGANS."

IT is announced that another of the "house organs," *i. e.*, a regular publication issued by a manufacturing concern, is to be discontinued; and this leads us to remark (at the risk of seeming to talk shop) that advertising by means of such publications has been repeatedly proven to be the most expensive possible way for machinery makers to advertise.

It is quite natural, perhaps, for a manufacturing concern which does a large business, and whose advertising bills are large, to conclude that by publishing a small sheet of its own, and attempting to make it more or less interesting in a general way, it can insert its own advertisements on a liberal scale, and by scattering these sheets broadcast among those who are buyers, do its own advertising at the mere cost of printing and postage. It seems all very simple and easy, but nevertheless experience shows that it is a mistake. People will not read nor preserve such publications; they never acquire any standing whatever; are never quoted or referred to as authorities on the subjects of which they treat, and are far more expensive than they are expected to be.

Lots of money is thrown away by machinery manufacturers in advertising, by the selection of "cheap mediums" and by general inattention, but there seems to be no more effective way of getting rid of money without return than by starting an organ and publishing one's own advertisements.—American Machinist.

PERSONAL.

Mr. A. G. Brown, of Wroxeter, has been appointed engineer of the Teeswater waterworks.

Mr. C. F. Sise, President of the Bell Telephone Co., Montreal, has been on a somewhat extended visit to Boston, Mass.

Mr. John Mullarkey, has been appointed manager of the Montreal Island Belt Railway. Mr. Mullarkey has had an extensive railway experience.

Mr. John Fensom, of Toronto, has been appointed consulting engineer to the East Hamilton Improvement Co., and will accompany Mr. J. N. Lake, the manager of that Company, to Pittsburgh, for the purpose of learning the latest improvements in inclined railway construction and operation.

Mr. Geo. Wilson, for several years employed in connection with the Bertram Engine Works, Toronto, has been appointed superintendent of the mechanical department of the St, John. N. B., Street Railway. Mr. Wilson carries with him the best wishes of many Toronto friends for successin his new position.

LUBRICANTS AND THEIR APPLICATION.

ONE of the most important things in connection with running machinery is its proper lubrication, writes a contributor to an exchange. Nine times out of ten those troublesome delays caused by a hot bearing are traceable to the lubricant, which is either entirely wanting or improperly applied. Frequently the men who attend to the oiling in factories do not take sufficient pains to do it properly. They allow the oil holes to become clogged with dust and dirt, so that but a small part of the lubricant reaches the bearing. Some others seem to think that a great deal of oil is necessary to the proper running of a bearing and they apply it so freely that it stands in pools about the bearings and machines. I have seen engines that almost stood in oil, yet they did not run any smoother than others which were properly cared for. A bearing needs but a small amount of oil at a time, but it needs it often. It is a good plan to fill oil boxes with wool or woollen yarn, as this allows the oil to reach the bearing in small quantities and also filters it. If a bearing becomes dry and heated, and consequently rough, there is nothing better than to apply powdered graphite with the oil, but, of course, it will not run through the wool. Where there are oil cups with tubes on the inside, as Fig. 1, it is a good plan to take two or three strands of woollen yarn and coil them around the tube, putting one end down into the tube. This wick will feed the bearing as long as there is oil in the cup.

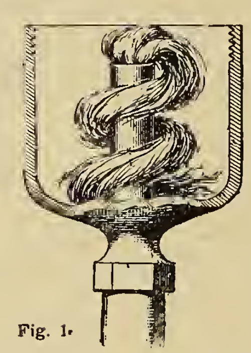
Fig. 1.

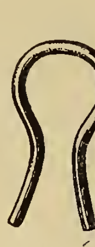
Fig. 2.

I was once bothered with the eccentric on an engine which I was running. Grit frequently dropped into the oil hole from above, which was just a hole drilled in the eccentric and countersunk on top. I tried putting yarn in, but it would not stay any length of time. I finally took a piece of wire and bent it in the shape shown in Fig. 2, and sprung it into the hole and put the yarn in the loop at the top, and it has not troubled me since.

THREE STEAM QUESTIONS.

(1) What is superheated steam?

(2) What is "latent heat," spoken of in work on steam?

(3) Will the material of a boiler affect the temperature of the steam made in it?

Vapor of a temperature above the boiling point corresponding to its pressure, is brought into the condition of a permanent gas instead of a vapor, and it said to be "superheated."

In passing from the liquid state into steam, the temperature of the water remains at the boiling point, which is determined by the pressure of the vapor produced. To make evaporation continuous, a certain quantity of heat must be added to the water or to the steam, for each unit of weight or steam formed. That heat does not raise the temperature of the water nor of the steam, but disappears, being used in keeping the water in the gaseous state; and the amount so used up without being perceived as heat, is called the "latent heat of evaporation."

Conversely, while steam, or any other gaseous substance or vapor, passes into the liquid state, its temperature remains stationary at the boiling point (or condensing point, which is the same thing) corresponding to its pressure; and a quantity of heat equal to the latent heat of evaporation at that temperature is produced in it. In order that condensation may continue, that heat must be transferred from the water (or other liquid) to some other body.

The boiling of water or other liquid will be retarded by its being in a vessel which is of a material which attracts the liquid. This will cause the boiling to take place by starts instead of regularly.—Power and Transmission.

PUBLICATIONS.

The J. Perkins Co., Toronto, have just issued a finely printed and illustrated catalogue devoted to fire hydrants, valves, water towers, &c., of which they are manufacturers, as well as of steam engines.

One of the interesting features of the December Arena is a symposium which discusses war and peace. The writers advocate the principles of the Peace Society and claim that the world has reached a plane of civilization at which all domestic and international disputes can be settled by arbitration.

At the recent annual meeting of the Peterboro' Carbon & Porcelain Co., the following officers were elected: President, Wm. Cluxton; A. P. Poussette, J. W. Taylor, Jas. Stevenson, Thos. Brooks, H. LeBrun, T, E, Bradburn, A. E. Dixon, A. L. Davis,

ELECTRIC RAILWAY DEPARTMENT.

EXPRESS AND FREIGHT SERVICE ON ELECTRIC RAILWAYS.*

THE answers to circulars showed that thirty-five roads are now engaged in the express business, while fifty-five are hauling freight. As a matter of fact, however, few roads through the country are doing a regular freight business, most of the so-called freight services partaking more of the nature of express. As operated upon street railways, the distinction between express and light freight service is so ill-defined that it is deemed best to consider both subjects together.

There are many points in the street railway as now conducted which make it almost an ideal agent for the transportation of packages and light freight. The great number of points reached by the cars, the absolute certainty with which they run, the thousand and one precautions taken against any stoppage of however short a duration, the rapidity with which distant points are reached, and many other causes combine to make the street railway of to-day a common carrier of exceptional advantages, when only short distances are considered. Many conditions will suggest themselves to railway managers in which an express or freight service may be made a paying institution. In the case of a town in which the railway station is some distance from the business part of the town, there can be no quicker, safer and better plan of conveying express and freight to some distributing point in the heart of the town, than by the street railway. Whether or not this will pay depends upon the amount of material, the competition, the distance, and the scope of the street railway franchise. A case often met with through the country is that of two towns connected by an electric railway, one of which, having no steam railroad, is obliged to get all its supplies through the other town. The installation of a freight service of some kind would at once suggest itself in this case, and the profits would depend upon the size of the towns, the character and occupations of the inhabitants, the distance between the towns, etc.

The operation of an express service on large city systems has not been attempted to any great extent. An example of a city road operating an express and freight service involving collection and a house to house delivery, is the case of the Southern Railway of St. Louis, which has been operating an express service on this plan for almost two years. The Southern Electric Railway begins in the heart of the city, and runs in a southerly direction for seven miles, following the general direction of the river to Carondelet. The territory penetrated is thickly settled for almost the entire distance, and in no essential does the road differ from the ordinary city street railway. Three trips per day are made upon schedule time by the express car, which is entirely independent, being mounted upon motors of its own. At the down-town end is a receiving station where a clerk receives all express consigned to the company, and keeps all the books pertaining to the service. The especial feature of this service, however, is the collection and delivery. This is effected by means of wagons, two of which are kept at the down-town end of the road, and three of which meet the car on all trips at certain points along the line. On receiving notice by mail, telephone, or otherwise, a wagon calls for a package, delivers it at the car, from which it is handed to the proper wagon, and delivered to the address marked on the package. A charge of ten cents a package is made for this delivery, and trunks are taken from houses to the Union Depot, checked, and the checks returned, for the sum of fifty cents. A corresponding charge according to size is made for the delivery of large boxes and bundles. A compliment to the efficiency of the service is paid by the large dry goods and clothing houses, which have ceased to run their delivery wagons into this part of the city, and now consign all of their bundles to the railroad company. Where formerly one delivery daily was made by the wagons, three are now made by the railway. An interesting feature of the service is that several large factories located in the southern part of the city consign all their freight to the electric express. The goods are put on the car, taken to the proper railroad stations, shipped, and the bill of lading returned to the consignor. Packages are received by the express car, C. O. D., the charges collected, credited to the proper account, and settlements made at the end of each month. The railway company assumes all the responsibilities of a common carrier, holding itself liable for all loss and damages.

Up to this point we have considered an express and freight service merely as a paying or non-paying institution, to be adopted in the one case and to be rejected in the other. There is another view which may be taken of the case, however, which is in many instances the most proper solution of the problem. This is to regard the establishment of this service merely as an auxiliary to the passenger traffic, operated whether or not it pays in order to gain increased passenger travel. The most notable instances of this sort are the roads which run from the hearts of our large cities out into the suburbs. It is manifestly to the interest of these roads to promote building and settlement along their lines, and how can they better attract builders than by giving their patrons all the advantages of city life, not only in furnishing them with rapid transportation to and from the city, but in aiding them in receiving their provisions and supplies. This calls for some form of express service, and although the receipts from this source may not equal the expenses, the increased passenger receipts and the advertisement given the road must also be taken into account.

If mail bags may be thrown on the front platform of a car, carried to their destination and delivered without causing any long stops, this is perhaps the best way of solving a mail service on a small scale; but in a freight or express service it is better that the work should be done with cars especially devoted to such service and by men especially trained for it. A single box car equipped with motors of its own will handle the light freight and express of quite a territory without any interference with the regular running of cars. A twenty-five foot car, equipped with double trucks, supplied with the most approved form of motors and controllers, and fitted up either as a mail car, express car, or combination car, can now be obtained for two thousand to twenty-five hundred dollars. A smaller car mounted on a single truck can be obtained for less money. If heavy freight is to be hauled, it should be carried in motor and trailer cars built especially for this purpose.

The rate charged on express matter is usually five or ten cents per package, while the freight rates vary from four to ten cents per one hundred pounds.

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* From a report of a Committee of the American Street Railway Association.

SPARKS.

An electric railway from Parry Sound to Ahmic Harbor is talked of.

A meeting of the shareholders of the Winnipeg Street Railway Co. has been called at the Board of Trade Building, Montreal, on the 5th instant, to sanction the issue of bonds of the company secured by mortgage on the assets of the company, to the amount of $400,000.

The Honolulu Electric Railway and Power Co., Limited, is being organized to construct an electric railway system in Honolulu. The promoters of the company are: James Dunsmuir, John H. Turner, Thos. B. Hall, F. W. McCrady, R. Menaugh and Clinton Graham Ballentyne, all of Victoria, B. C. The capital stock of the company is to be $625,000.

The town council of Niagara Falls are said to have recently discovered an old lease for a railroad right of way along the Niagara River. This lease is said to provide that the company using this right of way shall pay a rental to the town of $10,000 a year. The council, it is said, will endeavor to enforce this provision against the Niagara Falls Park & River Railway.

Application has been made to the county council of York by the Toronto and Suburban Electric Railway Co. for a franchise for the construction and operation of an electric railway from the end of its present system in Dundas Street, westward to Lambton and Islington, along Dundas Street. It is the intention of the company, if the franchise is granted, to commence construction at as early a date as practicable.

An electric railway is projected from Fort Erie to Port Colborne, Ont. The Point Abino Street Railway Co. are applying for incorporation with a capital stock of $100,000 to carry out the enterprise. The promoters of the company are: Leonard McGlashan, Humberstone; T. F. White and Donald McGillivray, Port Colborne, Ont.; John Foy, Toronto; William M. German and Edward C. Raymond, Welland; Eugene Coste, Buffalo, N.Y.; Henry C. Symmes, Niagara Falls, Ont., and Robert G. Cox, St. Catharines.

The Toronto World thus expresses its opinion regarding the interpretation placed by the Controller of Customs on the clause in the tariff referring to steel rails:—"The Government should do one of two things; it should either put a 30, or better still, a 50 per cent. duty on all rails, whether for steam or electric railways; failing this, it should remove the duty altogether. The present duty is inconsistent. It neither encourages, as it should, the rail-making industry, nor does it aid in the development of the country in the way it was expected to do."

At the recent annual meeting of the Montreal Street Railway. Co., the election of directors resulted as follows: L. J. Forget, James Ross, H. A. Everett, K. W. Blackwall, G. C. Cunningham. At a subsequent meeting of the directors Mr. Forget was made prrsident; Mr. Ross, vice-president and managing director, Mr. Cunningham, manager. Mr. Ross takes Mr. Everett's place on the board as vice-president, and Mr. Cunningham's as managing director. It is reported that Mr. Everett will shortly resign from the Board altogether and that Col. Henshaw will take his place.

The following statistical statement accompanied the annual report of the Montreal Street Railway Co. presented to the shareholders at the recent annual meeting of the company:

	1894.	1893.
Gross passenger receipts	$896,090 89	$750,751 78
Increase 1894 over 1893, 19.36 p.c.	145,339 11	....
Operating expenses	637,668 14	593,041 71
Increase 1894 over 1893, 7.52 p.c.	44,626 43	....
Operating expenses (per cent. of car earnings)	71.16	79.0
Net earnings	258,422 75	157,710 07
Increase 1894 over 1893, 63.86 p.c.	100,712 68	....
Passengers	20,569,013	17,177,052
Increase 1894 over 1893, 19.74 p.c.	3,391,061	....
Transfers	6,828,653	5,094,113
(Per cent. of passengers)	33.20	29.65
Cars run per day (average)	135	117

Mr. W. Forsythe, on behalf of the Hamilton Radial Railway Co., has made application to the city council of Hamilton for a bonus of $400,000, and right of way over Cannon Street from the eastern limits of the city to Railway Street. The bonus is to be payable on completion of each section of the road as follows: Hamilton to Niagara River, $100,000; Hamilton to Woodstock, $100,000; Hamilton to Guelph, $125,000; Hamilton to Berlin, $75,000. The city is to be given paid up stock of the company for an amount equivalent to the bonus, the city to guarantee interest on the bonds of the company for a period of ten years. The company promise to pave Cannon Street with asphalt, and build car shops and barns and a passenger station at a cost of $75,000.

CANADIAN GENERAL ELECTRIC CO.

(LIMITED)

HEAD OFFICE
65 TO 71 FRONT STREET WEST
TORONTO, ONT.

BRANCH OFFICES
1802 Notre Dame St., Montreal; 50 Main St., Winnipeg; 138 Hollis St., Halifax; Granville St., Vancouver.

Toronto, Oct. 26th, 1894.

Dear Sirs :—

Having by the removal of our Lamp Manufacturing business to Peterboro', consolidated this Department with our other manufacturing interests, we have been able to materially reduce the cost of production and at the same time improve the quality of our lamps, which are now the best on the market.

We have decided to give our customers the full benefit of this reduction, and will therefore from this date supply our Incandescent Lamps in not less than barrel lots at the following prices, viz. :

16 c. p. Lamps, 25 Cents each net
24 " 30 " "
32 " 35 " "

Five Cents per Lamp extra when ordered in less than 100 lots.

With many thanks for past favors,

Yours very truly,

THE CANADIAN GENERAL ELECTRIC CO.
LIMITED.

SPARKS.

The adoption of the electric light is being talked of by the town of Sweetsburg, Que.

A new 600 light alternating dynamo has recently been installed by the Sackville, N. B., Electric Light & Telephone Co.

The sum of $100,000 has been voted by the citizens of Vancouver, B. C., for the purchase of a municipal lighting plant.

It is proposed to utilize the electric plant in connection with the pulp mill at Sissiboo Falls, N. S., to supply light to the town of Weymouth.

Mr. T. W. Ness has again commenced the manufacture and sale of electrical supplies under the registered title of Messrs. T. W. Ness & Co.

The Victoria Electric Light Co., of Lindsay, Ont., are moving into new and more commodious premises, and are adding to their plant a Wheelock condensing engine, a large steam boiler, new generators, etc.

The Vancouver, B. C., Street Railway and Lighting Co.'s property is said to have been purchased by an English syndicate, and the present employees of the company are reported to have received notice of dismissal. The name of the new owner has not been disclosed.

Mr. Peter McGregor, of Ottawa, is said to have perfected improvements on electric heaters which will reduce the amount of current consumed, increase the heat product, and prevent the oxidization of conductors. The manufacture of these heaters will, it is said, be commenced shortly.

An Ottawa company composed of Messrs. J. W. McRae, Dr. Henderson, N. C. Sparks, S. Maynard Rogers, H. B. Spencer, Arch. Stewart, J. A. G. Trudeau, and E. T. Hubbell, has been formed, with a capital of $45,000, to manufacture a primary battery, the patent for which has been purchased from Mr. Charles H. Hubbell, of Washington, D. C.

The Wm. Hamilton Mfg. Co., Peterboro', have been given a contract for a Payne Automatic Corliss engine of 350 h. p. for the Victoria, B. C., Electric Light Works. Attached to the engine will be a Northey duplex condensing pump, which will be fed with salt water. The engine, which will be connected direct to shaft, is guaranteed to regulate within one per cent.

The People's Electric Co., of Windsor, have requested the privilege of submitting to the Council a tender for the city lighting. The municipality is at present operating its own lighting plant, but finds it necessary to purchase additional machinery. The People's Electric Co. believe that they can furnish the light at a cheaper rate than the city can manufacture it.

A resolution was recently passed by the shareholders of the Hamilton, Grimsby & Beamsville Railway Co., limiting the amount of stock to be placed upon the market at $100,000, and authorizing the directors to issue bonds sufficient to complete the road to Beamsville. It is understood that the traffic on the road has been so heavy that the advisability of double tracking the line is already under consideration.

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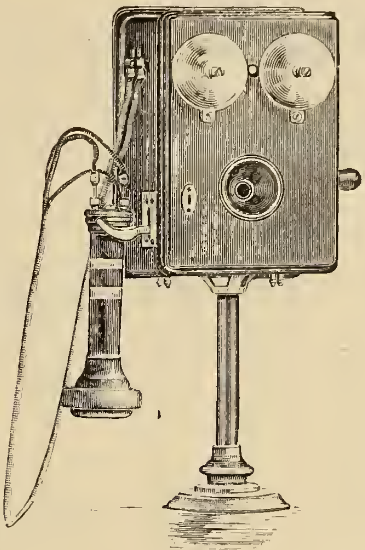

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SPARKS.

The electric light and power plant at Carberry, Man., formerly owned by McMillan & Oliver, has been purchased by Mr. H. Boyd.

Application is to be made to the Nova Scotia legislature for a charter for an electric light and power company, to operate at Parrsboro', N. S. The capital stock of the company is to be $10,000.

Mr. Geo. E. Kidd, Solicitor, has given official notice to the government of the intention of a company to apply for incorporation to construct an electric railway between Ottawa and Brockville.

A paper on the "A B C of Electricity," referring especially to the relation of the electric magnet to the permanent magnet, was recently delivered by Mr. H. Breck, Jr., before the members of the Kingston Association, C.A.S.E.

The Yarmouth Gas and Electric Light Companies were recently amalgamated. Subsequent to the amalgamation some of the shareholders of the Gas Co. brought suit against the directors, whom they charged with having fraudulently procured a controlling interest in the Gas Co., and by means of this interest having purchased at an exorbitant price the electric light plant of which they were the owners. It is reported that judgment has been given in favor of the plaintiffs for the sum of $248,000.

A series of interesting and instructive lectures on "The Steam Engine Indicator," are being delivered by Mr. A. C. McCallum to the Peterboro' Branch of the Canadian Association of Stationary Engineers.

The incandescent lighting business of the Royal Electric Co. in Montreal has rapidly increased. In March, 1893, the company supplied 28,917 lights; in March, 1894, 40,279; and 17th November, 1894, 50,316.

The report comes from Ottawa that a company with a capital of $100,000 is negotiating for the establishment in that city of a factory for the production of porcelain and carbons for electrical purposes. At Kingsville also, application has been made to the town council for certain privileges on behalf of a company who propose to engage in the manufacture of bicycles and carbons.

The Bell Telephone Co. have lately taken possession of their new exchange building at Ottawa. The new exchange is said to be most complete in all its arrangements, having been built for the special use of the company. The switchboard is wired for 1200 subscribers. The switch bells are operated by an electric motor in the basement. The wires are brought into the building through underground cables. These cables at present carry 2800 wires, but have a capacity of 7200 wires. The present length of underground cable is 47,811 feet. There are in use in the city upwards of 1000 miles of wire. The apparatus of the new building was installed under the superintendence of Mr. W. A. Tower.

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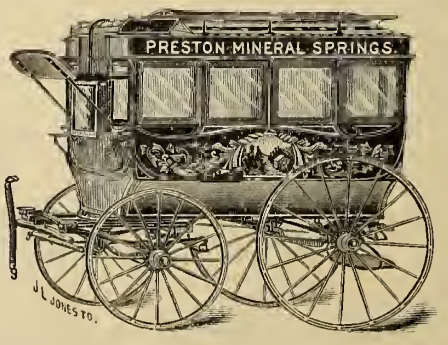

SPARKS.

The Halifax Street Railway Company's receipts for the year 1894, exceeded those of 1893 by $12,000, the amount being $104,152, of which the city received $8,332.

Below are given the gross receipts of the Montreal Street Railway Company for ten years, commencing 1885 and ending at the close of the company's business on the 30th September, 1894: 1885, $222,063; 1886, $252,186; 1887, $346,022; 1888, $386,468; 1889. $412,216; 1890, $431,389; 1891, $491,862; 1892, $569,810; 1893. $750,751; 1894, $880,000.

Mr. F. E. Handy, late engineer of the Hamilton and Beamsville Electric Railway, writes the ELECTRICAL NEWS from Worchestershire, England, where he is at present visiting, that he is surprised at the slowness of things electrical in England. Large cities and towns have not the electric light yet. There is a grand field for a concern to manufacture dynamos, lamps and motors. The field is practically untouched and railway work is not properly started yet. There is a poor affair at Walsall, a fairly good road in Liverpool and one in London—but that is all.

Application is to be made to the Ontario legislature at its next session to incorporate the Toronto, Hamilton & Niagara Falls Electric Railway Co., with power to construct an electric railway from Hamilton to Toronto, and from Hamilton to some point on the Niagara River, at or near Niagara Falls; and also a branch line from the village of Grimsby south through or near the village of Smithville to the village of Dunnville; and also for the usual powers to sell, lease and distribute electrical power. Messrs. Briggs & Lewis, of Toronto, are acting for the promoters of the enterprise.

The following patents for electrical devices have recently been granted in Canada: Commutator Connector, Electric Mining Machine, Electric Railway Block System, Canadian General Electric Co., Toronto; Electric Car, E. M. Boynton, West Newburgh, Mass.; Regulating Sockets for Incandescent Lamps, etc., Elias E. Ries, Baltimore, Md.; Electric Railway Signal, Frank E. Seagreave, Toledo, Ohio; Electrodes for Secondary Batteries, Henry C. Porter, Chicago, Ill.; Electric Conduit System, Hyrum S. Woolley, Paris, Idaho; Alternating Current Motor, Alternating Current Generator, Frank H. Sleeper, Coaticook, Que.; Electric Railroad Signal, Benjamin C. Seaton, Rochester, N. Y.; Electric Block System, The Electric Signal Co., New York, N. Y.; System of Electrical Distribution, Waldemar Meisner, Konigsberg, Prussia, Germany; Rheostat, Chas. A. Hussey and Chas. C. Eadie, New York, N. Y.; Method of Propelling Vehicles by Electricity, Ries & Henderson, Baltimore, Md.

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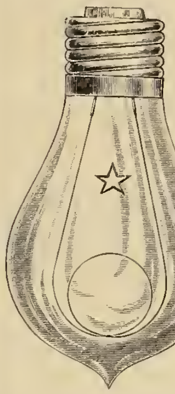

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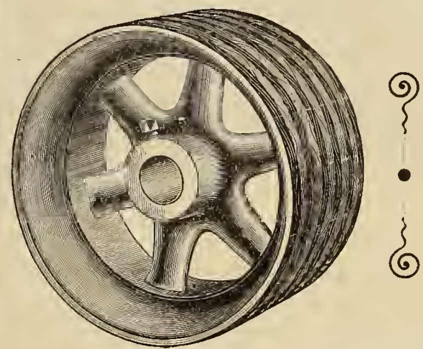

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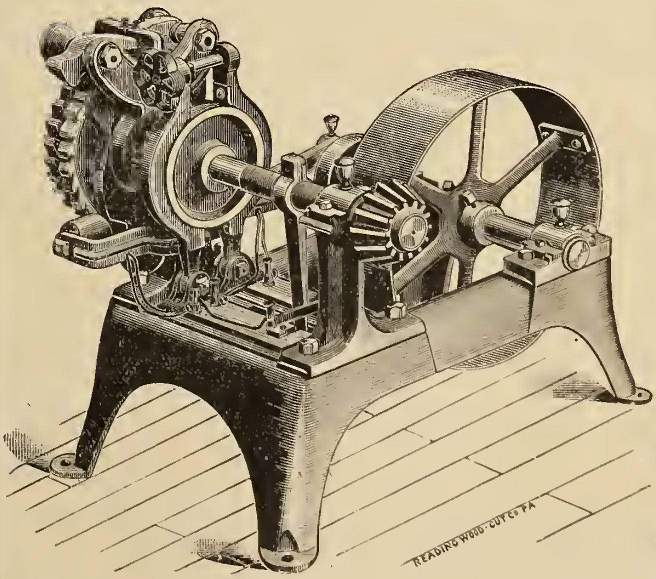

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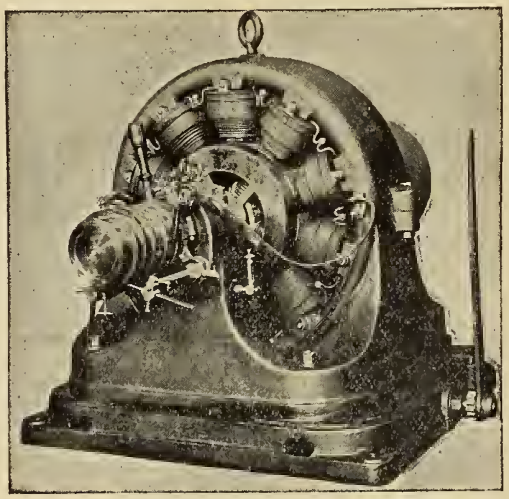

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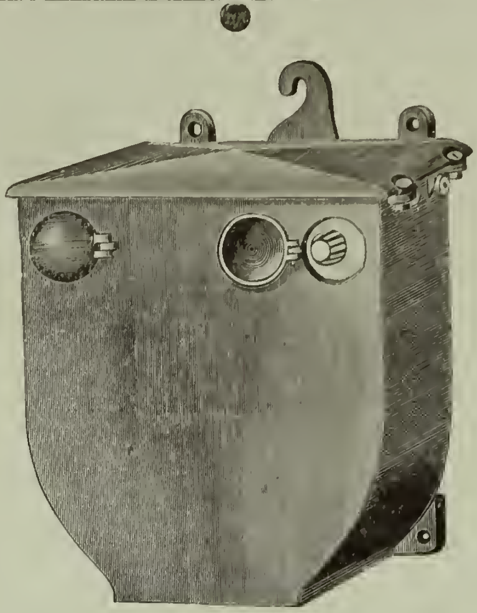

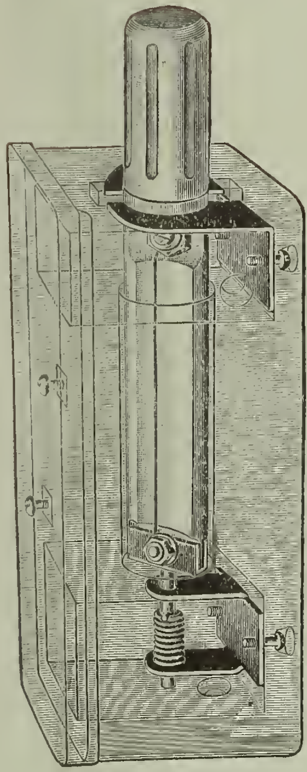

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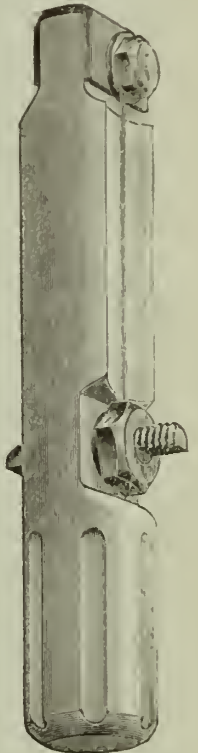

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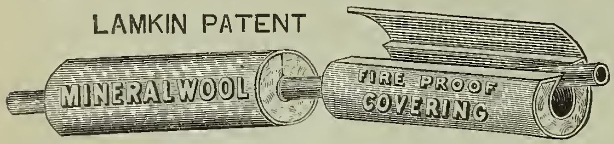

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